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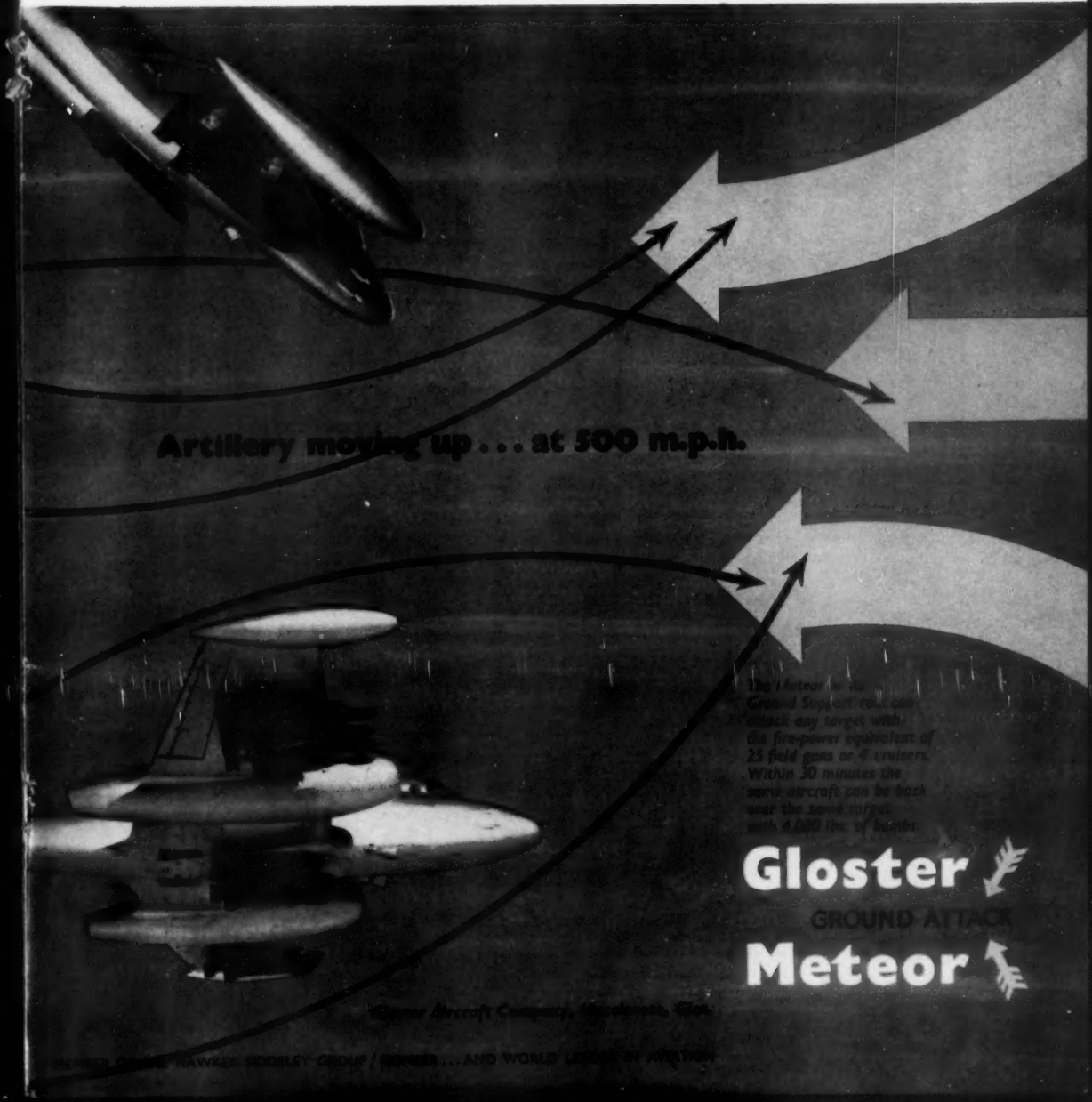

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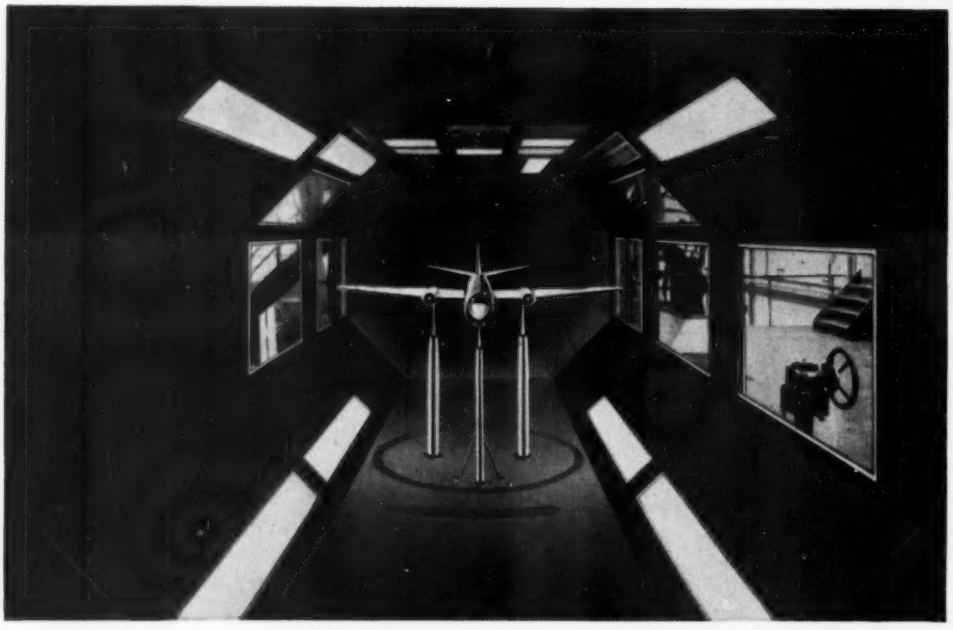

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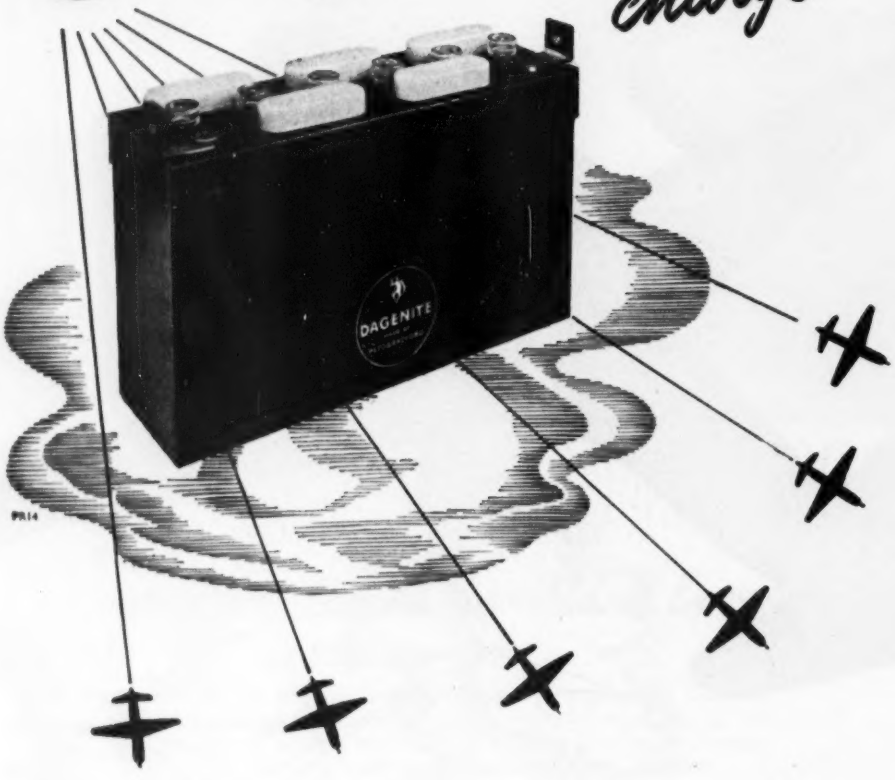

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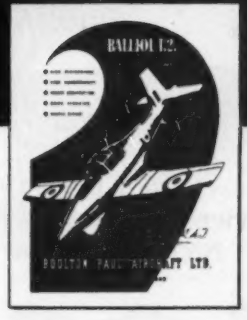

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Faith in the Flying-boat

THE flying-boat picture is a sombre one indeed: a few weary Sunderlands ranging the seaways like ghostly Flying Dutchmen seeking relief from their years of toil, while Sandringhams and Solents—fewer still in number—meet with shabbier luck than the Ancient Mariner himself, attracting not one in three, but only one in thousands, of airline voyagers. As for the stately Princesses, fate has ruled that they should ply not as swift argosies bearing the magic bales of commerce, but as troopships in the scheme of Commonwealth Defence. And derelict in their shadows lies the last of three pioneer fighter-boats, the S.R./A.1, which proved that British brains and hands had lost none of their cunning in applying a new propulsive system.

But through the prevailing gloom a rosy horizon is discerned far off, and the sorely-tried eyes of the faithful are directed towards it by two men—Ernest G. Stout, of Convair, and Henry Knowler, of Saunders-Roe. Mr. Stout's paper, *A Review of High-Speed Hydrodynamic Developments*, was truly a milestone in aeronautical literature and was duly reviewed in *Flight* (October 26th, 1951). Now, in the present issue, we summarize Mr. Knowler's Louis Blériot lecture, which was due to be delivered in Paris two days ago. Here many of the problems besetting the flying-boat designer are candidly set out and the proposed solutions expounded. By way of illustration are presented such delectable visions as a big Nomad-powered patrol boat and a ski-shod water-based fighter which really looks fit to throw the gauntlet to its rivals ashore. Then there are the pure-jet, medium-range Duchess, ultra-long-range transports, typified by the Princess, and powered with turboprops, and, finally, a glimpse of an atomic-powered flying ship of 500,000-600,000 lb gross weight—a big aircraft, as Mr. Knowler says, to contemplate as a landplane, but as a flying-boat acceptable without query.

To those who have the cause of the flying-boat at heart and who have followed its fortunes through the medium of these columns, Mr. Knowler's matter-of-fact thesis (though it has a good salty tang about it, with its pitching, heaving and porpoising, chines, keels and buttock lines) will come as a new avowal of faith by a leader in a great British cause.

Training For Craftsmanship

DURING recent years the aircraft industry, like many others, has come to know the youth who, discounting the value of a well-organized apprenticeship scheme, prefers to seek a job with little prospect of advancement but plenty of quick money. Now, we are glad to learn, there are signs of a change of outlook : more young men seem willing to learn a trade.

Current discussions of manpower shortages in the defence industries consistently stress the need for skilled workers as against unskilled. A firm that in one month has 200 men leave for jobs elsewhere, yet manages to recruit 300 others, appears to have no cause for complaint—until it is realized that perhaps 80 per cent of the 200 were men with years of service and goodwill in trades in which there were already shortages, while only some 10 per cent of the new intake have comparable experience.

Rates of pay underly the majority of cases of men quitting otherwise satisfactory jobs; housing difficulties, acute as they are, are a less frequent cause. The methods by which wage-rates are fixed can also bring injustices; men of outstanding skill, whose work has a valuable influence on a firm's production efficiency, may find themselves rated at the lowest common denominator of their particular trade. They are hardly to be blamed if they respond to tempting offers from other employers—often small "mushroom" concerns in which they can make better money, and perhaps with less overtime.

If and when such inequalities can be smoothed out, and with a return to less artificial conditions, the craftsman may once again take his rightful place in British industry; yet by that time there may be a dearth of younger skilled men to fill the jobs, and that is why we welcome the indications of a renewed interest in apprenticeship. Now, more than ever before, it is essential for schools, colleges and employers to encourage young men to appreciate quality of workmanship and the life-long value of skill in any trade or profession.

FOUR-LEGGED FREIGHT

From Cargoes to "Cowgoes" on the Channel Air Ferry

THE respective merits of tunnels and bridges are of little interest to the aviation fraternity and the thought of thousands of cows pouring through a Channel Tunnel must be rather bewildering to any man. Yet the Channel "airbridge" carried such traffic from the second week in November, 1951, until early this year.

In late October Silver City Airways received a contract to fly 1,800 head of cattle, *en route* from Ireland to Italy, across the 47-mile stretch of water between Lympne and Le Touquet, at a rate of about 300 per week.

Britain's trade agreement with Eire means that about 80 per cent of the Emerald Isle's cattle exports are sold to Britain at a favourable price, in exchange for releases of coal and other scarce materials. The remaining 20 per cent of edible Irish cattle are offered for sale to the highest bidders who this year have once more included rejuvenated Italy. Although the 1951 Italian live-beef shipments were smaller than in previous years, the various shipping agents who arrange transportation from Eire to the land of spaghetti looked to the air for a means of more efficient transportation across the Channel.

The recent system, therefore, was for the cows and bullocks to be shipped from Dublin to Liverpool and Birkenhead, railed to Westenhanger Station, near Lympne, put out to pasture for a few hours, flown across to Le Touquet in Bristol Freighters and finally railed to Italy and slaughtered.

It is a little known fact among we laymen that a bullock, in transit and away from pasture, loses 1½ per cent of its fat content every 24 hours. As the air trip saves the shippers more than a day in time and avoids a possible rough and weight-reducing sea crossing, it is calculated that on the original contract of 1,800 cattle some 30,000 to 40,000 lb of beef has been saved for the purchasers. As almost all these beasts were destined for slaughter, this represents about £10,000 additional revenue on the Italian retail market. If we are conservative and say there is a meat saving of £3 to £4 per beast this, plus the boat fare, actually comes to more than the figure charged to the shippers by Silver City!

On arrival at Westenhanger, one mile away from Lympne, the usual daily batches of 48 bullocks were treated to a few hours of Kentish pasture. Then, four at a time, they were taken to the airport by Thomas Diver's fleet of new Commer cattle-trucks and loaded aboard the waiting Bristol Freighters. The cattle were brought to the airport as aircraft capacity became available and were not kept waiting in their trucks on the tarmac. Two truck-loads of four bullocks made up the average aircraft-load of eight 11-cwt animals; but, quite often, eleven 8-cwt beasts were carried within the Freighter.

The method of loading, which was supervised by experienced men, was quite simple, as no form of ramp was required. The tailboard of the cattle-truck was lowered to meet the sill of the aircraft, protective side-boards were extended from the truck, and the animals, suitable encouraged by gentle words and brandishings from the capable cow-hands of Kent, were soon persuaded to transfer themselves from one vehicle to another. While the first cattle-truck was moving away, the second was already backing-up.

Protection from Kicking

A new type of aerial cattle-pen was delivered to Silver City for use in Operation Cow. Basically, it took the form of an oblong cage, constructed of metal tubes and canvas. This cage was speedily lashed inside the cargo hold and the animals stood athwartships, secured only by their halters to the tubular frame. This method proved to be entirely satisfactory and resulted in a very much quicker turn-round. Before the cage was introduced the system was to protect the sides of the aircraft with padding and install individual tubular-metal hurdles between each beast. This method, although efficient, wasted much time.

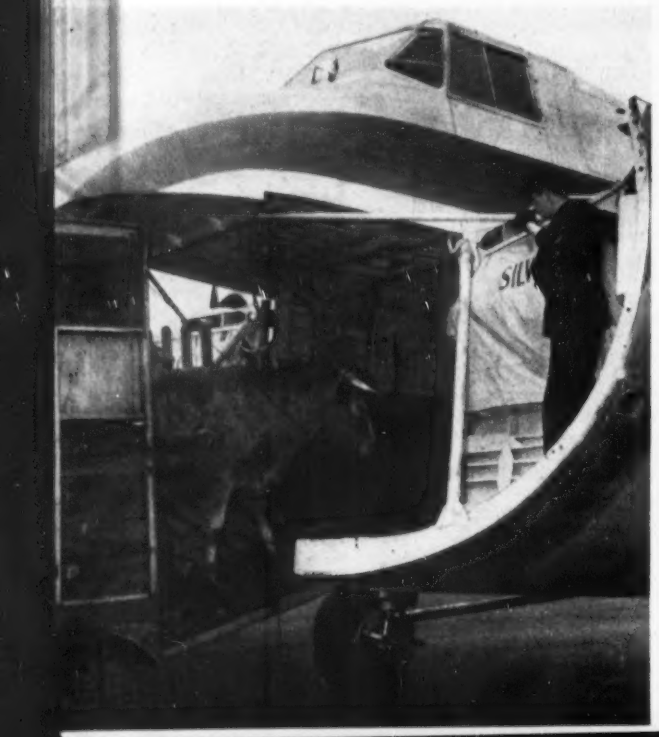
As the Bristol Freighter is not the quietest of aeroplanes, the reactions of cattle in the air were very interesting. The writer flew on the cow-lift many times and is convinced that the animals had absolutely no sensation of flying. In the first place they were unable to see out of their canvas-covered cage, and the whole effect must have seemed to them to be very much like a slow and lumbering passage through a very long and luxurious railway tunnel. At no time did the writer see any sign of nervousness in the air, nor did he hear a solitary moo amid the clouds. All the animals stood unbelievably still, perfectly balanced, and completely unconcerned throughout their flights. Always, however, there was a cow-marshal inside the hold ready to attend to his passengers' requirements.

There was sometimes a slight reluctance to exchange the comfort of the Freighter for that of the French cattle-truck that was always on hand to meet each aircraft as it landed after its 20-minute flight from Lympne.

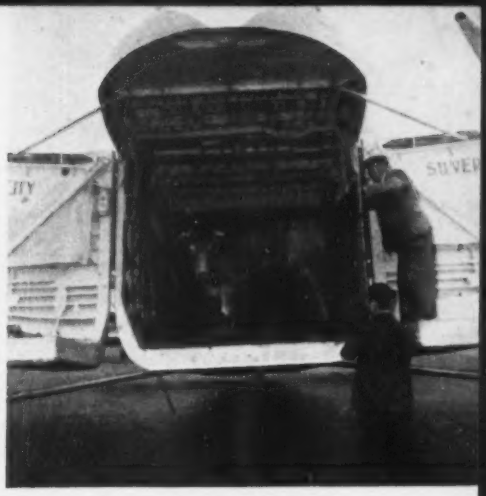
While Silver City's *average* shipments ran to about 300 a week and a flight every 90 minutes or so, things were a little less "average" in practice. A spate of bad fogs, torrential rains, and hold-ups on the railways resulted in a series of special efforts and slack days. In spite of these things, the overall plan was not disjointed, and on some days as many as 80 bullocks crossed the Channel in the Freighters.

Operation Cow proved a useful experience for Silver City. It meant that although the type of cargo underwent a radical change, the company was able to operate the same Lympne to Le Touquet air bridge all the year round at a high frequency. This was the first year that there had been heavy winter traffic, and the obvious result has been to make the overall running cost of the fleet of Freighters, and of the car ferry, very much cheaper.

J. S. W.



A beast walks calmly into the Freighter over the bridge formed by the lorry tailboard. Canvas hurdles protect the fuselage walls from hooves.



CATTLE FERRY: The more orthodox method of loading cattle by gang-plank, which Silver City Airways have now rejected in favour of entry over the lorry tailboard. The right-hand photograph shows the head-to-tail "sardine" arrangement of stowing the cattle (see opposite page).

FROM ALL QUARTERS

Flying-boats at Westminster

THE recent Brancker Memorial Lecture by Air Chief Marshal Sir Frederick Bowhill was the subject of a Commons question of March 5th. Mr. G. P. Stevens asked the Minister of Transport and Civil Aviation if his attention had been called to the lecture, which deplored the declining use of flying-boats, and if he would make a statement on the future use of flying-boats in this country.

Replying, Mr. J. S. Maclay, said that the Airways Corporations' future plans were based wholly on landplane operations, but two private companies registered in this country had acquired some of the flying-boats formerly operated by B.O.A.C. In answer to a further question, he added that there were some decisions made in respect of flying-boats in the days of the former Government and that he was examining these decisions very carefully indeed because it was open to argument whether they were right.

Helicopters also received some attention. Mr. Beswick said that for both military and civil purposes helicopters tended to be the machines of the future: would the Minister see whether he could arrange with the Air Ministry for more research into these matters and for the development to be speeded up? Mr. Maclay replied that a lot of work was proceeding on helicopters, adding "we are all most anxious to see them develop as quickly as possible."

In answer to a question, Mr. Ward, Under-Secretary of State for Air, said he did not consider the television mast now being erected at Wenvoe (Glamorganshire) was dangerous to aircraft.

Neat Power Unit for France's Trainers

The Société des Moteurs Potez, who are reported to have received large orders for engines for trainers, have recently undertaken the re-equipment of a large section of the Lorraine factory at Argenteuil. One of the first Potez units to be put into production there will be the type 6.D-00A six-in-line, seen above. Principal data: take-off output, 240 h.p. at 2,530 r.p.m.; normal output (s.l.) 230 h.p. at 2,500 r.p.m.; bore, 4.875in; stroke, 4.73in; overall length, 62in; max. height, 27in; width, 20in; dry weight, 485 lb.

President Truman's Defence Budget

PROVIDING an illuminating comparison with corresponding British figures (quoted in *Flight* last week), the following extracts from the budget now before Congress show appropriations generally similar to those of 1951-2; the most significant increase is for guided missiles.

	1951-52 dollars	1952-53 dollars
U.S. AIR FORCE:—		
Aircraft procurement	7,348,949,001	10,706,348,000
Guided missiles	130,887,287	300,000,000
Industrial mobilization	16,279,274	3,766,000
Aircraft research	74,227,000	74,671,000
Missile research	116,052,000	110,381,000
U.S. NAVY:—		
Aircraft procurement	3,851,406,507	3,323,880,000
Ordnance for new aircraft ...	51,079,000	37,397,000
Guided missiles and drones ...	33,852,000	152,800,000
Technical training equipment ...	10,938,000	6,455,000
Aircraft modernization	29,203,000	18,368,000
U.S. ARMY:—		
Aircraft procurement	60,946,000	36,657,000

P.P.S. to U.S. of S.

MR. ANTHONY BARBER, who has been appointed Parliamentary Private Secretary to the new Under-Secretary of State for Air (Mr. George Ward), is M.P. for Doncaster. Seconded to the R.A.F. from the Army in 1940, he served as a pilot, and on special duties with Coastal Command, with the rank of flight lieutenant. Then in 1942, he was taken prisoner, and the notable part which he played in the escapes from Stalag Luft III earned him a mention in despatches.

Like many other P.O.W.s, F/L. Barber devoted part of his time in captivity (most of the remainder was spent in planning escapes) to studying for a peace-time career, in this case the law. Repatriated, and released from the R.A.F. in 1945, he took an honours degree at Oriel College, Oxford, in politics, economics and philosophy, and was called to the Bar in 1948. He won his Doncaster seat in a straight fight with the Labour candidate at the last election.

Doubts about Deltas

IN an article "Wing Shape of the Future", published in the Australian journal *Aircraft*, Mr. H. K. Millicer, Dipl.Ing., M.Sc., A.F.R.Ae.S., who is aerodynamic design engineer in charge of the Aerodynamic and Initial Projects Office at the Government Aircraft Factories, Australia, says that "essentially the delta wing is only a high-speed (M=1.2 to 1.4) short-range proposition."

Among the disadvantages of the delta wing Mr. Millicer lists the need for a great deal of engine thrust to maintain a reasonably flat approach angle, remarking that this feature precludes any engine-off landing at low speeds. There is nothing, he says, that could be done to improve the bad features at the present stage of aerodynamic development unless one returns again to external surfaces such as large fins, high-mounted tailplanes, boundary-layer fences, wing-tip slots, or boundary-layer suction equipment.

FROM ALL QUARTERS . . .

The acroplane again becomes a familiar Christmas tree, but, even so, it is far more difficult to fly at low speeds than an orthodox aircraft.

"No amount of wing thinness or sweep back appears to delay the compressibility drag rise much beyond the Mach number of 0.87," says Mr. Millicer. "It seems that we shall have to be content with cruising at Mach numbers of 0.9 to 0.93 for medium or long-range aircraft for the next ten years or so. Therefore it appears to me that the delta wing configuration is unnecessary. . . . I am firmly convinced that in the next two or three years we shall see a turn away from sweptback wings to very thin wings with either slight or no sweepback at all."

Summing up, Mr. Millicer says: "The delta wing emerges as a purely supersonic, short range aircraft with very short endurance. Due to its stability troubles near the stall it is very 'touchy' to handle, difficult to land, dangerous to stall. It should be satisfactory for short-range pilotless missiles or even for short-range manned fighters. But it does not look promising as an economic proposition for a medium- or long-range subsonic transport, bomber or even fighter."

Improved Leduc Ramjet

THE fourth Leduc prototype, designated Leduc 021, is now nearing completion at Argentueil and is likely to fly this year. A Turboméca Marbore turbojet at each wing-tip should give the 021 a great advantage over its predecessors in that it will be able to make an unassisted take-off from the ground; the earlier prototypes have been air-launched.

A centre-line undercarriage is to be used, with wing-tip skids. It is stated that two 20 mm cannon will be fitted, while estimated performance figures—presumably for the ramjet assisted by both turbojets—include a time of under two minutes for the climb to 32,800ft, and a duration of 15 minutes at 49,200ft.

French Turboprop Progress

FOR the past four years the S.N.E.C.M.A. have been developing a medium-power, axial-flow turboprop, the TB-1000 which was described in *Flight*, May 12th, 1949, page 555. Now comes the TB-1000-A, in which the output has been raised from some 1,400 to 2,000 equivalent b.h.p. No details of the modifications are available, but they have not, apparently, affected the major rotating assembly or the overall weight.

At Villaroche on January 14th the first TB-1000-A unit was put through a brief maximum-power test, during which a total equivalent b.h.p. in excess of 2,000 was recorded; the next day, the same engine completed a 15-hour test at maximum continuous power.

Lancasters for the Record

COMMENTING on a recent Air Ministry news release concerning the tenth anniversary of the first Lancaster operation—a minelaying sortie on the night of March 3rd, 1942—A. V. Roe and Co., Ltd., remark that readers may be interested to see a production analysis of the 7,366 Lancasters which were built (7,366, apparently, is an accurate figure—7,333 was quoted in the anniversary story). The following, then, are the delivery totals, as given to A. V. Roe by the Ministry of Aircraft Production in November, 1945:

Maker	Mk No.	Output
A. V. Roe (Manchester and Yeadon)	1	896
" " " "	3	2,774
Armstrong Whitworth (Coventry)	1	919
" " "	2	300
" " "	3	110
Vickers-Armstrongs (Castle Bromwich and Chester)	1	300
" " " " "	2	235
Metropolitan-Vickers (Manchester)	1	944
Austin Motor Co. (Birmingham)	3	136
" " "	1	150
Victory Aircraft (Canada)	7	180
	—	422
	TOTAL	7,366

Australian Acceleration

THE Australian Department of Supply has placed a contract with the Fairey Clyde Aviation Co. (Pty.), Ltd., for a number of test rockets for use at Woomera; the company has also been asked to develop a number of rocket types supplied from the United Kingdom. Electrically welded, precision steel tube will probably be used for the motors, British Tube Mills Pty., Ltd., of Adelaide, having been asked to guarantee a continuous supply.

The Armstrong Siddeley Viper expendable turbojet used in the Australian pilotless aircraft is reported to have a service life greatly in excess of requirements and is, therefore, to be suitably modified—the reverse of usual practice! The aircraft, which has been given the name Jindivik, was designed by Mr. Ian Fleming with Mr. le Cheminant as technical director. Prototypes have been built at the Commonwealth Aircraft Corporation factory at Port Melbourne; production models will be produced by Chrysler (Australia), Ltd., Finsbury, South Australia.

At least two examples of the aircraft have made successful trial flights, according to reports, and another destined for Woomera Range is featured in the Pathé newsreel generally released this week. This one bears the numbers B.4 on the nose and A.92.4 on the tail. A brief description of the Jindivik in the January 25th issue of *Flight* included illustrations of B.1. The span of the square-cut wings is less than 20ft and the length is 22ft. It may be controlled from the ground or from another attendant aircraft.

H.R.H. THE DUKE OF EDINBURGH made an extensive tour of the Royal Aircraft Establishment, Farnborough, on Thursday of last week. He is seen here with (left) Mr. Duncan Sandys, M.P., the Minister of Supply, and Prof. A. A. Hall, who was recently appointed Director of the R.A.E.

La Bell France

THE French national group S.N.C.A.N. have purchased a licence for the manufacture of the Bell 47D-1 helicopter. Powered by the 200-h.p. Franklin flat-six engine, the type will be mass-produced to meet both civil and military requirements.

Thunderjets for Italy

THE latest European air force to receive Republic F-84 Thunderjet fighter-bombers from America, under the mutual defence assistance programme, is Italy. The first batch arrived at Brindisi on March 8th. It is presumed that these machines are F-84Es, powered with the Allison J-35 turbojet.

Easier Logistics

THE Chief of Transportation of the U.S. Department of the Army, Maj.-Gen. Heileman, recently described the impact of the helicopter on military transportation as "all but impossible to over-estimate."

The U.S. Army, he said, were regarding the helicopter as an improvement on the traditional ground-transport methods, rather than as the introduction of a modified aeroplane. Use of the helicopter would aid military transportation more than did the first motor vehicles.

Transparent Metal

A METHOD of coating glass with a thin, transparent, electrically conducting film has been developed at the National Physical Laboratory, Teddington, and is now being patented. The layer is of a metallic oxide. Not all metals can produce transparent oxide films; tin is a notable example of one which does, and is readily available, although expensive.

The tin is deposited, as the element, on the glass by normal industrial methods which give very even distribution. The glass is then heated to near the softening-point and cooled; this oxidizes the tin and renders it transparent. Finally, the film is washed in water and dried; this increases its electrical conductivity. The oxide film is then hard, and inseparable from the glass on which it is deposited; it is also resistant to chemical attack.

Visibility reduction is negligible—for all practical purposes—while the resistance to current is about 1,000 ohms across opposite faces of any square area. Electrical heating can thus be used at a sufficient current density to prevent the accretion of ice or snow, or to arrest interior misting due to condensation.

WE MEET A MAJOR

—*for a Chat about Migs, Sabres and Chinese Polishing*

Major James A. Jabara, U.S.A.F., the subject of this interview.

LAST Sunday afternoon in London was more depressing than usual; but we walked into a Piccadilly hotel, shook hands with a dark-visaged young major in U.S.A.F. blue, and were soon up-along with him in a Sabre over the Korean battlefront. At least, one could easily imagine so once he had lit his cigar and got to talking. And without appearing in any sense what we "Britishers" would term a line-shooter, the major is a good talker; which is fortunate for him, for, on the invitation of the Chief of Air Staff, he has been addressing R.A.F pilots and staff officers on the gentle art of Mig-mauling (see page 309). The name: Major James A. Jabara; principal decorations, Distinguished Flying Cross (three times) and Distinguished Service Cross (twice); two-war combat record, nine German aircraft and six Mig-15s.

The first conversational pawn was deftly moved into the square marked Mig versus Sabre, and the major followed us as closely as if we had been wearing North Korean markings (a red star with an inner red circle and outer blue circle, as he explained for our edification). The Mig-15 intercepter—for it was designed exactly as that—is, in his opinion, faster above 35,000ft than the F-86A and E. (Perhaps the critical level is 33,000, perhaps 36,000; too little is yet known for precision on this point.) But the difference does not appear great—five or six knots at 35,000ft or so, building up as height increases to 50,000ft. And lest there should be any doubt concerning the last figure, Major Jabara assured us that both the American and the Russian machine can attain it, though at levels of this order it is impossible to pull more than one or two g in manœuvring. Below 35,000ft the Sabre has it all over the Mig in level speed and manœuvrability; and it can go firmly on record that Major Jabara does not consider the Mig to be capable of supersonic speed. As for range and diving speed, the Sabre is superior regardless of height.

On the subject of speed the major maintained that a much slower aircraft—even a Vampire—might bag a Mig if one were "bounced" as it might well be, while flying at cruising thrust; and for most of its time at altitude (35-40 minutes without drop tanks) the Mig is probably using about 90 per cent power. Two or three minutes are required to work up to top speed and this sluggishness to accelerate is one of the reasons why the slower Thunderjets have had more victories than defeats—a second, of course, being their use of the excellent American radar gun-sight, whereas the Migs probably have some outmoded type of gyro-sight. The secret of the radar sight is that the range of the target is automatically fed into a computor so that the Sabre pilot literally has the measure of his target at all times. The major recalled somewhat ruefully that the Communists had captured one of these radar sights as long ago as December, 1950, when the first F-84E landed in their lines.

And as in estimation of firing range, so is the Sabre superior in range in terms of miles and endurance in hours. It could, in fact, fly to the Yalu hunting-ground from its base 250 miles or so away and return even without recourse to drop-tanks, though it would have only five minutes' combat-time remaining. Naturally, the general practice is to take the extra fuel along. As is well known, the Sabre has an exceptionally high performance even with the wing tanks in place (the major's Machmeter was indicating 0.95 in a wing-tanked Sabre during his last combat); but inevitably they detract from speed and manœuvrability. Their value in Korea is that they allow an easy 25-30 min sweep-and-combat in the Yalu area.

This matter of range brought Major Jabara round to the make-up of the Sabre as a fighting aircraft. Like the Mig, it is an intercepter; but not only is it much superior in range, and is thus suitable for escort and penetration work, but it is heavier built, and, in his view, structurally sounder. As for its armament of six 0.5in guns, he openly confessed that he would trade them for four 20 mms, which combination, he said, would be fitted on all new U.S.A.F. fighters. But he would never exchange his "50s" for the 1 × 37 mm plus 2 × 23 mm formula of the Mig.

He had something especially interesting to say about this Russian armament—that the 37 mm shells appear to be fused to explode at a set range (1,200ft or so), so that there is little danger from this particular gun if one is ahead of or behind this point. The gun can often be seen puffing smoke as it fires at its slow rate.

If the Sabre can get in a good burst in the engine cockpit region it means exit for the Mig-man, either on ethereal wings or in his ejector seat; and notwithstanding "informed opinion" to the contrary, the Mig *does* have an ejector seat, which the occupant is often only too eager to resort to at an awkward moment—even if his Mig should fall into a spin, for instance, while ample room remains for recovery. Multi 50-calibre hits on a Mig wing (which carries no fuel) can give very disappointing results indeed, and then the need of cannon is particularly apparent.

Since Major Jabara left Korea last May the tactics and discipline of the Communist pilots have discernibly improved. Formerly, after breaking formation, a number of them seemed to lack initiative, V.H.F. instructions (in Russian, averred the major) notwithstanding. The leaders are now very good indeed.

In the early combats the Migs flew in what he described as a Luftwaffe gaggle, but now they are using the finger-four combat formation, as do the Americans themselves, and some very good teamwork has lately been observed on the part of Migs thus arrayed. The business in hand is too fast and furious for individualists: teamwork does the trick.

The U.S.A.F. medium bombers having denied the Migs the use of airfields in North Korea, the Communist fighters are operating from two fields north of the Yalu. From these they are often to be seen taking off and landing and appear to behave much as an F-86. On one of the fields—Antung—there are two excellent runways, upon one of which Migs are often to be seen ranged ready to scramble from either end of the second. There are dispersal pens, but, said the major, "they don't disperse too much."

Making Tracks

He had some observations on the subject of contrails, which can, of course, be a benefit or a handicap. Often during activity in the Yalu area the Communists, with their radar, are well aware of the presence of Sabre formations; but, unless the Migs are at contrail height, the Sabres may be unaware of their location. The critical height, of course, varies with temperature. Usually around 32,000ft, it may be as low as 27,000, and on occasions it has even been necessary to ascend to 40,000 or even 46,000ft to get above it.

When we had thrashed out the Mig/Sabre business as well as we could without kicking over the traces of security, we turned to more general considerations of the Korean conflict. About 80 per cent of the United Nations air effort, the major reminded us, is now deployed to tactical ends for the direct or indirect support of ground forces. In this, strong opposition is met from 20 mm and 40 mm flak, some of it radar-controlled, and losses have been relatively heavy. Nor have the B-29s been having things all their own way, and daylight operations have been very seriously curtailed.

Enemy bomber action has been slight since November, when eleven Tu-2s and four of their Mig escort were slaughtered in five minutes. There is a big reserve force of Tupolevs and other aircraft in the Mukden area. Much of the enemy's slight bombing effort has been made by Po-2s (Tiger Moth equivalent) using hand grenades and mortar shells. No ground-strafing Yaks have been seen since last April. The night-flying B-29s are now meeting with opposition in the form of twin-jet night-fighters, but these do not seem to be very aggressive at present—in fact one at least has joined formation with a Superfortress.

We have already noted Major Jabara's assurance that all new U.S.A.F. fighters (by which we inferred single-seaters) will have four 20-mm guns. It was perhaps too much to hope that he might have told us something of the improved Sabre—the more sharply swept F-100; but though he admitted he had seen the mock-up, he would say nothing except that it is going to be a very good fighter indeed, and quite a large one.

The major concluded the session by giving us a recognition wrinkle which will interest the spotters, for it concerns the Mig-15 itself. Insignia are as we have already described. The nose is painted bright red and the finish is brilliant silver—"like a shiny dollar"—so waxed and polished that the major estimates that about 400 Chinese are kept busy polishing each Mig . . . H. F. K.

SHAKESPEARE IN NICE: British European Airways Elizabethan R.M.A. "William Shakespeare" at Nice Airport on March 5th during a two-day proving and demonstration flight from London to Geneva, Sion, Milan, Pisa and Nice. The aircraft did not make a landing at Pisa.

HERE AND THERE

The King's Cup—Still

THE title of the King's Cup Air Race is to remain unchanged. The Royal Aero Club has been informed that "it is Her Majesty's desire that the race should continue to be called by that name and that the challenge cup presented by His Late Majesty should continue to be competed for." The contest is to be one of the events forming the 1952 National Air Races at Newcastle-upon-Tyne on July 11th-12th.

Willi in Spain

THE former German aircraft designer Willi Messerschmitt is reported to be working for the Hispano-Suiza company in Madrid. He is said to have had a number of talks with heads of the firm and to have received a total of 3,000,000 pesetas (£100,000) as back-payments of salary.

Nautical Ornithology

"I SUPPOSE there is no chance of changing the name of the G.R.17 from Gannet to something else; I have always disliked that name. On the lower deck, 'Gannet' has always meant someone greedy and noisesome who eats up someone else's food the whole time and has no graces at all. This is not a good name with which to christen one of our latest aircraft."—Mr. James Callaghan (Cardiff South-East), during last week's debate on the Navy Estimates.

Australian Avons

LAST Monday, March 11th, Sir John Black, Managing Director of the Standard Motor Co., was due to meet the Australian Minister for Defence Production, Mr. Eric Harrison; their discussions, it was stated, would chiefly be concerned with the forthcoming production of the Rolls-Royce Avon in Australia.

Mig v. Sabre Again

WHILE deadlock continued round the Korean conference-table, the air war last week flared up again. On March 5th, 28 Sabres surprised a formation of 70 Mig-15s crossing the Yalu river from Manchuria, with a reported result of 5-0 in the U.S.A.F.'s favour. Next day, in a fight which ranged as far south as Pyongyang, six Sabres destroyed one of a formation of 22 Mig-15s, without loss to themselves.

Confident Homecoming

WHEN the expedition ship *Norsal* arrived recently in the Canary Islands after three years in the Antarctic, she unloaded her two Saab Safir (Gipsy Major engined) spotting aircraft. They were then taken to Gando airport, re-assembled and, with four expedition members as passengers, flown back to Stockholm by their pilots, seen in the picture below.

U.S. Aircraft in Indo-China

HANDING over the tenth consignment of Douglas B-26 Invaders to the French Air Force in Saigon last week, the head of the U.S. Military Assistance Advisory Group, Brig.-Gen. Brink, is quoted as saying that French striking power in the area had been trebled by American-supplied aircraft. The machines have been flown 12,500 miles round the North Pacific Ocean area during delivery.

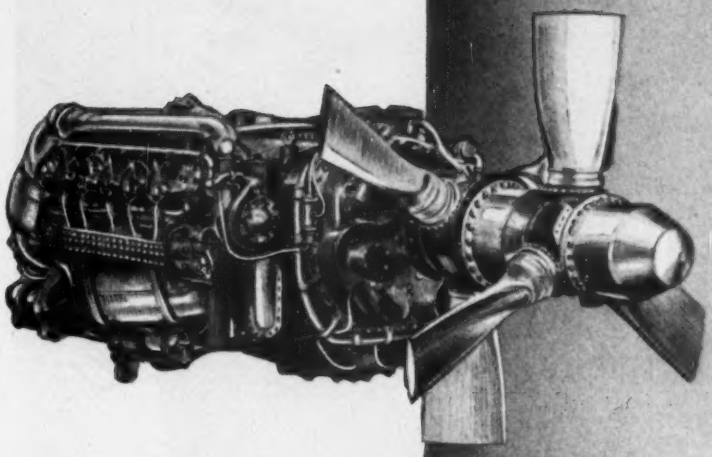
The Press-on Spirit

AFTER an adventurous flight from London in a Proctor V, G-AIEV, Mr. J. H. H. Laxton has arrived in Sydney, Australia. On November 17th, while landing on the little Indonesian island of Soemba, he damaged his undercarriage. He spent 17 days living on native food, then managed to contact the Dutch authorities by radio and asked them to send a ship. The aircraft was manhandled seven miles through the bush, taken on board, and ferried to Jakarta, where, with the help of a native carpenter, the pilot spent three weeks in effecting repairs. He then completed his 10,726-mile flight to Darwin. The Proctor had left England on November 1st in company with a Gemini, and both aircraft—which had been purchased from W. S. Shackleton Ltd.—reached Singapore (the Gemini's

FUEL CONTAINERS (left) of synthetic rubber are being tested by the U.S. Army. Holding five gallons, they have been dropped from aircraft at 2,000ft without bursting.

CANARIES TO STOCKHOLM: Capt. Reinhold von Essen (right) chief pilot on the "Norsel" expedition, second pilot Olof Wijkmann, and one of the two Safirs (see above).

NAPIER



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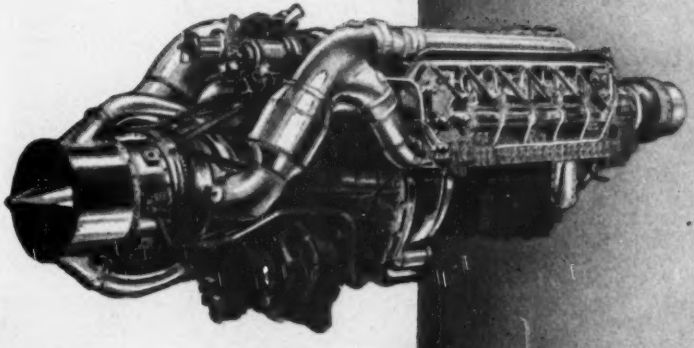

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HERE AND THERE . . .

destination) without incident. As we recorded at the time of their departure, the Proctor was destined for delivery to Somerset Airways at Muttaburra.

R.Ae.S. Lecture Amendments

THE lecture which was to have been given before the Royal Aeronautical Society on March 6th was postponed. The lecturer was to have been Mr. J. D. Hayhurst, B.Sc., A.F.R.Ae.S., and his subject was *A Study of Airport Noise*. A further "main" lecture has now been added to the Society's programme: next Thursday, March 20th, G.C. E. A. Whiteley, D.F.C., B.A., A.F.R.Ae.S., will speak on *Terminal Air Traffic Control*. The lecture will be given at 6 p.m. at the Institution of Civil Engineers.

Stainless-steel Nacelles

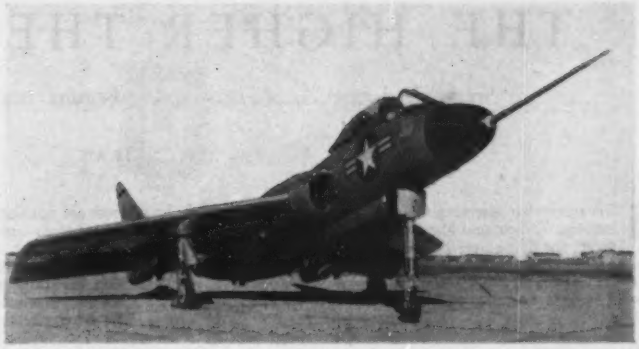
FUTURE production Lockheed P2V-5 Neptunes are to have engine nacelles made entirely of stainless steel. The new nacelle is stated to be both stronger and lighter than the original light-alloy pattern, while increased fire-resistance should be a further advantage. A very hard alloy is specified, which, according to the makers of the sub-assembly (Solar Aircraft, San Diego), has raised a number of problems in forming.

Two Electrical Exhibitions

THE annual private exhibition arranged by the Radio and Electronic Component Manufacturers Federation will take place this year at Grosvenor House, London, W.1, from April 7th to 9th. An electrical engineers' exhibition is being organized by the Association of Supervising Electrical Engineers and will be held at the New Hall of the Royal Horticultural Society, London, on March 28th and 29th.

Anson Accident Inquest

AT the resumed inquest at Petersfield, Hants, on the four occupants of the M.C.A. Anson which crashed on January 4th, verdicts of accidental death were returned. After evidence had been given by the sales manager of Helliwells, Ltd., who had carried out the maintenance on the Anson at Stansted, the Coroner said that there was no suggestion that the aircraft had not been properly maintained, or that Capt. A. A. Betts was not a competent pilot. The jury added to their verdict a rider suggesting that "parachutes be carried in civil aircraft, at least when they were on test." (The Anson had been carrying out evaluation trials of the Decca Flight Log.)



SHARPER CUTLASS: The latest—F7U-3—version of the Chance-Vought Cutlass deck-landing tailless fighter of the U.S. Navy has a re-designed nose and cockpit enclosure, seen here to advantage. Armament is heavier than on former, lower-powered, variants and it would appear that the guns are now housed in the enlarged jet nacelles. Note the length of the nosewheel strut.

IN BRIEF

THE new £8 million "cat cracker" at Stanlow refinery (Cheshire) is now in commercial production at a rate of over one million tons a year. Its completion marks the final stage in Shell's £30 million U.K. refinery expansion programme.

* * *

Rollason Engines, Ltd., of Croydon Airport, have appointed W/C. C. E. Payne, of 47 Queen Street, Melbourne, as their exclusive agent for the whole of Australia. W/C. Payne and Mr. D. B. Bennett, director of W. A. Rollason, Ltd., commanded a Baltimore and Beaufighter squadron respectively in the Western Desert, and were re-united by an article and photograph in the aviation Press.

W/C. C. E. Payne, whose new post in Australia is announced here.

Yachting enthusiasts are reminded that the current (March) issue of *Yachting World* is the annual Fitting-out Number, a greatly enlarged issue packed with useful advice to those about to prepare for their season's sailing or motor-boating.

* * *

Mr. F. G. W. King, technical director at the Dunlop Research Centre, Birmingham, arrived in Calcutta recently to advise on technical, research and management questions at the company's 142-acre factory there. Aircraft tyres are now among its many products.

* * *

The Spetry Gyroscope Co. of Canada has announced that it is building an aircraft instrument plant in Montreal for the Government. The works will have an area of approximately 85,000 sq ft and will eventually employ about 600 people. Initial production is likely to begin next month.

* * *

Mr. H. T. Parker recently began a round-the-world trip on behalf of the Plessey group. He sailed in R.M.S. *Oronsay*, and expects to arrive in Australia on March 24th. He will be carrying out a detailed marketing survey of Australia and New Zealand and meeting agents in those territories; then he will fly back *via* Canada and the U.S.A.

CARRIED IN CASE: During the past few years the American Helicopter Co. has produced a succession of very small experimental machines, mostly powered by pulsejets on the rotor-blade tips. Their latest, seen here, is the XH-26, which looks less rudimentary than the usual run of such miniatures. Weighing under 300 lb, it is said to be collapsible into a 5ft by 5ft by 14ft container which could be dropped by transport aircraft.

THE HIGHER THE FEWER

Some Thoughts on Airline Safety-heights over Hilly Terrain

By J. C. NEILAN

IT is somewhat alarming to see that some operators of air services accept one thousand feet as ample margin of safety for flying over mountainous country. There was a time when this view was probably justified by lack of evidence to the contrary, and because the nature of the flying was what would now be called "special V.F.R." or "contact flying."

The modern traffic-control systems, insisting upon I.F.R. flying at rigidly controlled heights, from which it is frequently next to impossible to get clearance to ascend or descend in order to avoid unexpected icing conditions or turbulence, make it all the more important that the term "safety height" should mean exactly that—a height which is safe.

The history book of aviation has been blotted on almost every page with a succession of aircraft which have, usually in bad weather, collided with hills, the wreckage nearly always being found within a hundred feet or so of the top of the hill.

In these days the reason is rarely that the pilot, lost, has sneaked down to get below cloud and have a look. Airliners disappear only minutes after routine messages indicate that all is going according to plan. Climbing parties later find the remains near the top of, usually, the highest local peak.

The regularity with which these wrecks occur spoils the safety record of almost every operator, and proves that man has not yet completely conquered the air. The strength of a chain is the strength of its weakest link, and I suggest that in this case the weak link is the inability of the modern (or more frequently the obsolescent) aeroplane to climb in adverse conditions, such as with slight icing or with partial power failure, faster than the down-currents which frequently occur in strong winds in hilly country. If that excess power required for rapid climbing is absent, the only alternative should be to fly higher, so that the loss of height experienced cannot bring the aircraft to a dangerously low altitude.

At this stage I can imagine many readers putting down this article and saying to themselves—"Another of these gliding enthusiasts harping about his beloved up-currents and down-currents. From what I've read about them their currents are so small that they have the greatest difficulty in staying in them, even in their super-sailplanes designed specially for the purpose. Aeroplanes flash through them in a matter of seconds, and are rarely affected by more than two or three hundred feet." True! But not the whole truth. A little more reading about gliding would reveal that rates of ascent and descent exceeding 2,000 ft/min for several minutes have been encountered by many of these sportsmen when investigating wave conditions.

In many of these crashes on which evidence has been obtainable it has been apparent that there was little or no warning of impending disaster. This is just exactly what a gliding enthusiast would expect. Orographic and wave lift is strictly localized to the near vicinity of the hill causing it, though it might extend down-wind for some miles in the form of a series of lee waves. The thing to remember is that what goes up must also come down, and that, where a hill causes a strong up-current, there will also be a strong down-current nearby. In strong winds over hilly ground one can expect turbulence, often severe at low levels, but it is often confined to those levels by an inversion layer, above which the air is smooth, and flight is pleasant—until . . .

It is reasonable to suppose that a hill can affect the air-flow over it only to a certain height, and very often this limit seems to be something like twice the height of the hill above its summit. But in really strong winds the vertical currents can extend, apparently, well up into the stratosphere. The late Karl Erik Ovgaard reached 55,000ft during his last flight, according to the sailplane's barograph record, and heights of 40,000ft are not unknown. In Britain, evidence provided by lenticular cirro-cumulus clouds shows that we can expect wave lift, and sink, at any normal airline-flying-height up to 30,000ft. As British gliding is normally a week-end sport, the fact that only half that height has yet been reached by gliders here is not significant.

The strength and extent of the down-currents to be expected in wave conditions depend on various factors, chief of which are the strength of the wind, and the height and shape of the hills. The strongest down-current is normally the one immediately behind the hill, and is often very turbulent, while subsequent lee waves are more often weaker. If the hill is in the form of a long ridge, the wave will also roughly follow its shape. The steepness of the hill, too, has a considerable effect on the strength of the currents.

Aircraft flying in the same area but in different directions will be displaced vertically by different amounts, depending on the length of time they spend in passing through the waves. Flight down-wind will result in the smallest displacement, flight into wind results in a smaller ground-speed and, therefore, a longer time in each wave with consequent greater displacement. Flight parallel to the waves will result in maximum displacement if in the wave slopes, or in no displacement if along the trough or the crest.

It is fun to fly the waves when they are shown up by a layer of strato-cumulus, the top surface of which faithfully reproduces the wave form. It is a very different matter to the pilot who is flying in continuous cloud, and it is he who may encounter sudden dangers due to ice formation, and to much greater turbulence (especially in the down waves) than is usually experienced above cloud. This might, if he was not prepared for it, lead to loss of control of the aircraft, although, if he is at all such times securely strapped in his seat, even by the simple lap strap, he should always be able to keep his machine under control; even so, he may be unable to prevent a fatal loss of height if he has chosen too low a safety height.

Out-of-date Margin

Which brings me to the main point of this article. A thousand feet is reckoned by some to be ample safety height for any conditions. At one time I would have agreed. Aviation history and experience during the last few years lead me now to suggest the following scales for assessing safety heights.

The height to be topped by the safety height would be the highest peak within 30 miles of track. In winds less than 30 kt, safety height would be 2,000ft above that peak. In winds greater than 30 kt, safety height would be 3,000ft above the peak. These safety heights would be subject to the provisos that: (*a*) hills less than 1,000ft above the lowest ground within thirty miles would be ignored, and (*b*) hills over 5,000ft above the lowest ground within 30 miles would warrant another 1,000ft being added to the safety height. The sector safety heights would be published in the operations manual as heights above sea level.

If it should be thought that I have pitched these safety heights too high, it should also be remembered that winds are frequently stronger than have been forecast, sometimes 75 per cent stronger, and that it is quite usual for winds low down over hilly districts to be locally as much as double the general wind, owing to the funnelling effects of valleys.

Finally, the very words "safety height" should be pondered over. There are degrees of safety, as there are degrees of risk, but the degree of safety required in flying airlines is the highest possible. The addition of 1,000ft on safety height might well have entirely prevented those many accidents in which the wreckage has been found near the summit; surely it is well worth while?

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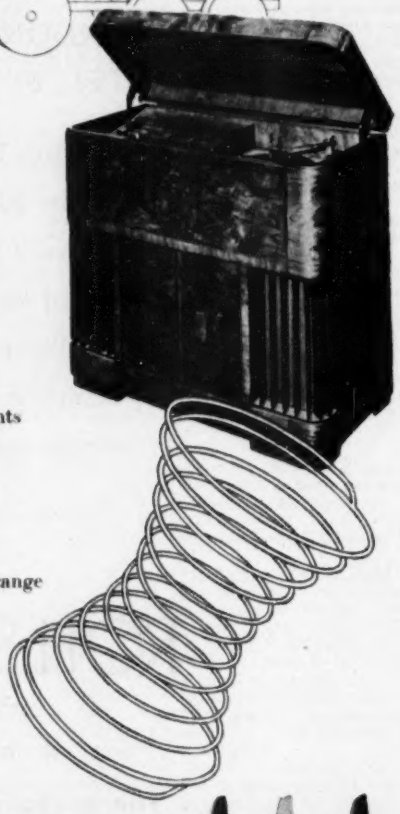

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THE composite airscrew blade developed by Rotol, Ltd., represents a marked advance over previous practice in that it enables an airscrew of a high propulsive efficiency to incorporate an effective internal de-icing system.

The standard Rotol airscrews developed for the Viscount and Bristol 175 employ blades of solid duralumin, but there appears to be no valid reason why this internal de-icing installation should not be applicable to any type of solid blade. As seen in the accompanying illustration, the leading edge of the duralumin blade is finished to a profile around which a space is left when the leading edge sheath is put on. Within this space are accommodated electric heating elements, one on each side of the blade leading edge.

The elements are flat strips, varying in width between one and two inches, of woven glass-cloth in which are interwoven lengths of electrical resistance wire. Seven-stranded ribbon wire—a phosphor-bronze of between 36 and 41 s.w.g.—is used, and its single length is so arranged in the glass-cloth as to extend back and forth several times between the blade root and to within about four inches of the blade tip.

The woven element is impregnated with raw neoprene and cured in an autoclave to form a compact, firm unit; it is then dipped in neoprene and thereafter bonded with a Bostik cement to the inside faces of the leading-edge sheath. This sheath is formed from 0.048in beryllium-copper sheet, through-riveted to the duralumin blade; countersunk rivets are used, the heads being finally ground flush and filled. The root of the sheath is secured by a through-bolt of large diameter. The final blade-assembly is then ground smooth so as to maintain sectional contour fidelity.

The spinner is likewise equipped with resistance heating; a disc element is cemented to the inside of the spinner nose, while further elements, shaped like the gores of a parachute, are arranged over the remainder of the spinner interior.

Three-phase power at 208 volts is supplied to the airscrew from an engine-driven alternator. The current is first led to three rows of brushes in a housing usually attached to a convenient point on the front of the engine reduction-gear casing. The brushes then transfer the current to three slip-rings in an assembly secured to the rear face of the spinner back-plate. These slip-rings are connected to groups of terminals, each group consisting of three bolts—one for each current phase—and each feeding one blade; current for the spinner is drawn from an appropriate-phase terminal in each of three of the groups. The spinner current is taken through spring-loaded plungers in order to obviate the necessity of disconnecting wiring when the spinner is removed.

In operation, the heating current is cyclically controlled by a time-switch, and is applied alternately to the engine air intake and to the spinner and blades.

The de-icing sequence resulting from the rapid heating and cooling is beneficial from the point of view of aerodynamic efficiency and, of course, in the economy of electrical consumption. The cycle time is variable, but will usually be of the order of 30 seconds "on" and 90 seconds "off." It may be found worth while making the cycle time controllable from the cockpit, in order to counter varying severities of icing.

During the cooling period, ice is allowed to form over the nose of the spinner and the leading edges of the airscrew blades. Being a poor heat-conductor the ice layer acts as an insulator, with the result that the heating current causes a much more rapid rise in temperature than would occur on an ice-free surface. The ice in immediate contact with the heated surfaces melts, and the entire accretion is then removed by centrifugal force.

A special advantage of cyclic heating is that it prevents supercooled water from coming into contact with a continuously heated surface, from which it would flow rearwards to freeze over the remainder of the blade.

The current taken on an airscrew of the size fitted to the Viscount is 1 kW per blade and 2 kW for the spinner—a total of 24 kW for a four-engined aircraft; it should, however, be noted that this load is not continuous. The spinner current is particularly heavy, since the most severe icing is usually experienced where centrifugal force has the least effect. Further, a build-up of ice on the spinner would, in many turboprop installations, tend to starve the compressor of air.

In practice, it is stated, the composite-blade airscrew has been found to work very well, and to be resistant to all normal wear. The beryllium-copper leading edge sheath, although thin, is sufficiently hard to resist abrasion from particles of sand and similar air-suspended matter, while being no more vulnerable to impact—from, say, ice thrown from an adjacent airscrew—than sheaths of more conventional types.

The airscrews used on the prototype Viscount 700 (which is at present engaged on de-icing trials) employ composite blades with resistance heating and, to this end, were designed with unusual straight leading edges; it is, however, now possible to form the sheaths with double curvature.

FARNBOROUGH PRIZE-GIVING

"I AM afraid our results are not quite up to last year's standard: then we took first place out of 2,500 candidates; this year we have only a 'second'—out of 2,695." This comment upon a recent examination was made by Mr. R. D. Peggs, M.A., M.I.Mech.E., A.F.R.Ae.S., Principal of the R.A.E. Technical College, at the annual distribution of prizes and certificates on March 5th.

It would, of course, be invidious to single out the achievement of any particular student, or even to attempt to list the total number of degrees, scholarships, medals and certificates which are gained by R.A.E. apprentices each year. It may, however, be mentioned that the prizes—distributed on this occasion by Mr. Kenneth Pickthorn, D.Litt., M.P., Parliamentary Secretary to the Ministry of Education—when neatly stacked, covered a large table; they were arranged between a pair of superbly finished bookends made by an apprentice, which, as is the tradition at Farnborough, were afterwards presented to Mr. Pickthorn.

The Principal paid tribute to the late Mr. W. G. A. Perring, C.B., former Director of the R.A.E. and Chairman of the College's board of governors, whose memory is to be perpetuated by the institution of a Perring Memorial Prize, awarded this year for the first time. Mr. Peggs was also able to announce the award of an annual scholarship to a full-time course at the School of Gas Turbine Technology, made available to the college by Power Jets (Research and Development), Ltd., through the good offices of Mr. D. L. Brown, the S.G.T.T. Principal.

Perhaps the only jarring note struck during an enjoyable afternoon was the announcement by Mr. Peggs that severe limitation of lecture-room space would make it necessary to restrict the intake of new students for the next session. Though no doubt sympathetic, Mr. Pickthorn, as "the man from the Ministry," confined his address to happier topics. Although, as he put it, he was an "academician," he was able to recall the shooting-down of his B.E.2C by an Albatross as evidence of a former disparity of equipment between Great Britain and her enemies. It was certain, said Mr. Pickthorn, that Farnborough would not let such a state of affairs happen again.

R.Ae.S. ASSOCIATE EXAMINATION

NAMES of candidates successful in the associate fellowship examination of the Royal Aeronautical Society last December are announced as follows:—

Part I.—I. F. Burns, Ilford; F. J. Butters, St. Albans; S. G. Corps, St. Albans; V. N. Ferriman, Headington, Oxford; J. F. G. Hast, Hatfield; M. E. King, Potter's Bar; D. W. Pickston, Reading; D. K. Ray, London, S.W.10; E. C. Turner, Hatfield; W. B. D. Wardle, Shenfield; J. D. Watkins, Reigate.

Part I (Abroad).—F/O. W. Raj, Jodhpur, India; A. V. Ranga Rao, Madras, India; Cpl. T. W. Thomas, M.E.A.F.

Part II.—B. R. A. Burns, Coggershall; R. Boocock, London, S.W.18; M. P. Harvey, Eastleigh; W. A. Page, Leicester; G. S. Pool, Hatfield; A. Syme, Bathgate, W. Lothian; F. I. V. Walker, Hull.

EXIT the AIRPORT COACH?

Tourist Air Travel May Raise a Still Bigger Road-traffic Problem

NOW that the introduction of tourist-class services seems likely to bring airliners carrying a hundred or so passengers, we must rid ourselves of the idea that motor coaches will continue to be an adequate means of transport between airports and city centres. This will be a problem not only for London Airport, but equally for Idlewild, Le Bourget, Schiphol, and many others. Berlin will be one of the few exceptions, for Tempelhof is comparable in situation with Battersea Park in London.

When British airlines began in 1919 a single Daimler six-seater motor-car was all that was needed to take passengers between central London and Hounslow, Cricklewood, and (later) Croydon airports. Today, even big coaches are beginning to prove inadequate; and when all traffic is moved to L.A.P. from Northolt, they are likely to create traffic chaos in the already overcrowded streets of Chiswick, Hammersmith, and Kensington. Up to the time of writing, no workable plan to overcome this difficulty has been announced, but there can be no doubt that we must at once rid ourselves of this motor-coach mentality.

The best solution seems to lie in a recent suggestion for building an airways terminal (with a helicopter landing-place on the roof) at the South Bank site. This adjoins Waterloo Station, from which there is a direct railway line to Feltham. From there a branch line could be run right into the traffic-centre of L.A.P., and trains could do the journey in 25 minutes from Waterloo. It would also be a comparatively simple matter to run such airport expresses right into the new airways terminal building on South Bank. Further time might also be saved by completing at least some of the Customs and immigration formalities on the trains.

When Imperial Airways built the present Airways Terminal at Victoria, a few years before the 1939 war, they were accused of grandiose planning; but already it is far too small, and B.O.A.C. and B.E.A. both have to spread themselves inconveniently in many parts of London. If an adequate terminal could now be built at the South Bank, B.O.A.C. could collect all their chicks under their wing from Brentford, Victoria, Heston, Piccadilly, etc., and B.E.A. could do the same from Ruislip, Regent Street, Kensington, Northolt North Side, etc. Foreign operators, too, might be leased offices in a gigantic Airways House.

New York is already meeting with similar problems, for though Idlewild on Long Island is reached by a magnificent, broad highway such as has been visualized for London, at fine week-ends the route is choked with holiday traffic. On a fine Sunday afternoon in April, 1951, it took me ninety minutes to drive by car from midtown New York to Idlewild.

In Johannesburg it is planned to connect the new Jan Smuts Air Port with central Johannesburg by a new broad, straight road; the same is being done to connect Kentucky Airport with the centre of Salisbury (Southern Rhodesia); and, probably, motor coaches will prove adequate to serve these towns for many years. Even so, both centres, and others such as Cairo, Buenos Aires, and Rio, would do well to look far ahead and follow the lead—if London is wise enough to give it—of building an adequate airways terminal connected to the airport by rail. Airlines could then start saving money by making the ticket operative only from take-off to landing—as, in fact, is already being done by some operators of reduced-fare services. G. D.

DA VINCI'S MASTERPIECES

THE Leonardo da Vinci Quincentenary Exhibition which opened at the Royal Academy of Arts in London on March 6th ncludes a number of aviation exhibits of great historic interest.

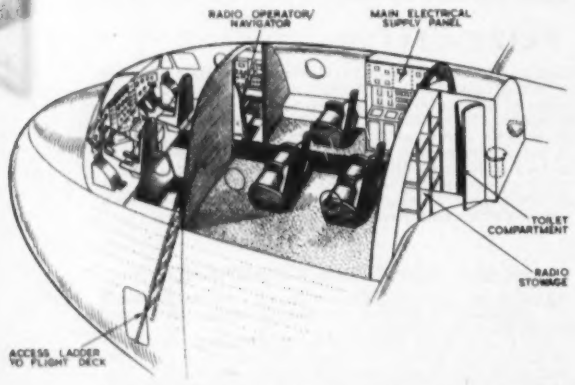
Leonardo da Vinci carefully studied the flight of birds and a number of his classic drawings of bird-flight are shown, with the collection of designs for wings and flying machines.

An attractive display lent by the Science Museum shows da Vinci's drawings of flying machines, a helicopter and a parachute, together with well-constructed models based on these designs. One of the flying-machine layouts includes what must almost certainly have been the first aircraft safety-belt.

Da Vinci's drawing of a ballista reminds the visitor rather forcefully of a V.1 launching ramp, while a drawing of a "webbed glove for swimming in the sea" was a five-century-ahead vision of World War II frogmen.

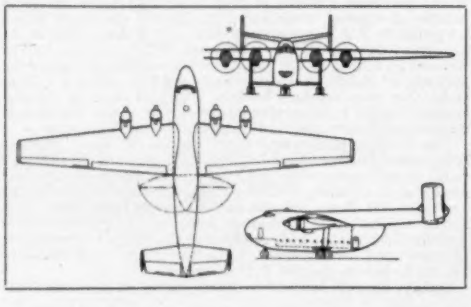
The exhibition will remain open until the end of May.

PASSENGER COMFORT in the Mk 2 UNIVERSAL FREIGHTER



A proposed layout for a three-flight-crew compartment, and behind, on the flight deck, a "stateroom" for five passengers (the tail-boom cabin accommodates sixteen). Larger clear-vision screen panels are to be provided for the crew. The access-ladder will be raked forward to clear the cargo-floor extension.

RECENTLY we were able to announce that Blackburn and General Aircraft, Ltd., have received M.o.S. instructions to go ahead with work on the Mk 2 Universal Freighter, which has been in abeyance for many months. The chief difference between the Mk 1 and Mk 2 is, of course, the use of Bristol Centaurus engines in place of Hercules, while the new mark will have a tubular tail boom above clamshell-type rear loading doors. The main cargo floor will be 4ft longer. A proposed interior change—illustrated in the sketch on the left—is the provision of a passenger compartment on the after part of the flight deck.



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Six Bristol [illegible]

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Martin PBSM-1 Marlin, with water flaps (under-water rudders). These combine the functions of water brakes and water rudder.

Consolidated-Vultee XP5Y-1, turboprop-powered, reconnaissance and transport flying-boat. A number will be supplied to the U.S. Navy.

THE FUTURE OF THE FLYING-BOAT

The Blériot Lecture: Saunders-Roe Chief Designer Foresees Far-reaching Advances

PARIS, which alternates with London as the venue for the Louis Blériot Lecture, seemed certain to attract a large assembly of aeronautical technicians on Wednesday last, March 12th, when Mr. Henry Knowler, A.M.I.C.E., F.R.Ae.S., director and chief designer of Saunders-Roe, Ltd., was due to deliver the fifth lecture of this important series. The lecture was to be read in French by M. l'Ingénieur en Chef Benoit, director of l'Office National d'Études et des Recherches Aéronautiques, and a cocktail party and dinner were to follow.

Mr. Knowler introduced his paper in retrospective vein, recalling that Louis Blériot's epic flight across the Channel in 1909, was "the inspired inception of a new era of travel." He then went on to describe representative contemporary flying-boat types—for ocean patrol, civil flying, fighting and amphibious operation—before turning to recent technical development.

First he discussed air drag, remarking that the high air drag of flying-boats relative to landplanes was not inherent in the type, though it was admitted that up to and during the Second World War flying-boat hulls were poor aerodynamically. Analysis had shown that the most serious cause of drag was the main step, although a badly shaped bow could also contribute seriously to the increase. A step which retracted in flight was obviously the solution to the problem; it had been tried, but the weight and difficulty of maintenance had ruled it out as a practical proposition. Another solution used with considerable success was the addition of a fairing behind the main step.

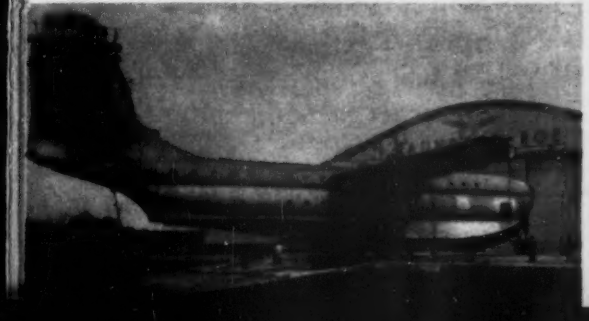
Mr. Knowler summarized by stating that model tests indicated that without sacrificing hydrodynamic qualities, by the application of the various possible means of drag reduction, the basic drag of the ideal streamline body need not be increased more than 10-12 per cent in converting it to a suitable hull form. This cost in drag could be compared with approximately 4-5 per cent increase which must be accepted for a typical landplane fuselage.

Discussing water resistance, the lecturer said that because of the inter-action of the various components of the resistance, a change benefiting one item would almost certainly have a detrimental effect on the others; therefore the modern flying-boat hull tended to be a well-balanced compromise. Improvement in the hydrodynamic lift of flying-boat hulls had been subject to considerable research, and work was still being done to this end, since the lowering of the hump drag could pay high dividends. One method explored was the use of hydrofoils by the use of which it should be possible to provide additional lift at low speeds for low cost in resistance. The most successful experiments had included two sets of foils, one at the bow and the other—the main lifting foils—just aft of the c.g. "Ladder" systems, which might include pronounced dihedral, had also been used. In their application to a flying-boat a possible solution was to use hydrofoil lift up to medium speeds and, after the foils had cavitated, to use the planing lift from the lower surfaces. Subsequently the foils would retract completely into the streamline body. The subject, in the lecturer's opinion, was worthy of further research because of the advantages offered in reducing both air drag and water resistance.

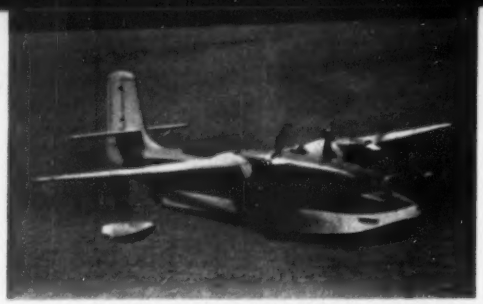
Somewhat allied to the hydrofoil was the hydro-ski. This obtained its lift from the water pressure on its lower surface in a similar manner to the planing lift of a boat's planing-bottom; but a considerably higher loading could be used and, in consequence, a higher attitude of the planing surfaces was necessary. The efficiency was poor compared with a normal boat form, but the system had the advantage that complete retraction into a streamline body was relatively simple. Hydro-skis were a comparatively recent development but considerable research had already been done in England and America in which their application to high-speed designs had been investigated. The possibility had been shown of having a highly stable hydro-ski system which was capable of lifting an aircraft body off the water at relatively low speed. The hydrodynamic efficiency of a hydro-ski was low but, because of the possibility of total retraction, the system was very suitable for water-based fighters.

Probably the most important factor in determining the general configuration of a flying-boat was the propagation of spray. Spray occurred in two forms: that emanating from the forward contact of the planing bottom with the water surface (ribbon spray) and the heavier form of spray—"blister"—which left the chine at its point of contact with the water. Both forms were due to the peak pressure developed in the stagnation area where the planing bottom intersected the solid water. Ribbon spray was fairly light and although it might cause inconvenience in misting up the windscreen and so on, it had no damaging effect on the structure, and since it first travelled forwards over the bottom surface, it could be directed downwards by curvature below the bow chine. On the other hand, blister spray had free release laterally and rose in a hollow cone of heavy spray. The height to which it rose determined the relative position of the airscrew tips and, in some cases, the position of the wing and tailplane above the water. There were various methods of estimating spray height, but perhaps the most

Saunders-Roe Princess long-range transport, with Bristol Proteus turboprops. The first flight is due this year.



Saunders-Roe S.R./A.1 experimental jet-propelled flying-boat fighter (two Metrovick Beryls), precursor of a transonic design by Saunders-Roe.



Short Sealand amphibian, with two de Havilland Gipsy Queen piston engines; an excellent example of its class.

THE FUTURE OF THE FLYING-BOAT . . .

successful was that based on the results of tests made in America on a series of hulls having varying length beam ratios and deadrise angles. Analysis of these and other results had made it possible to produce curves based on spray heights, from which the aircrew tip-heights necessary for satisfactory operation could be determined.

Investigations to determine means of suppressing blister spray showed that local curvature at the chine, which terminated horizontally, or nearly so, had practically no effect on spray height. Reflex curvature at the chine was found to increase the spray height, due to the greater force at which the spray impinged on the local water surface after leaving the chines. Transverse bottom sections which were hollowed from keel to chine were an improvement over straight bottom sections, but since no satisfactory definition of this curvature existed, comparison of the relative merits of various amounts of curvature had not been made.

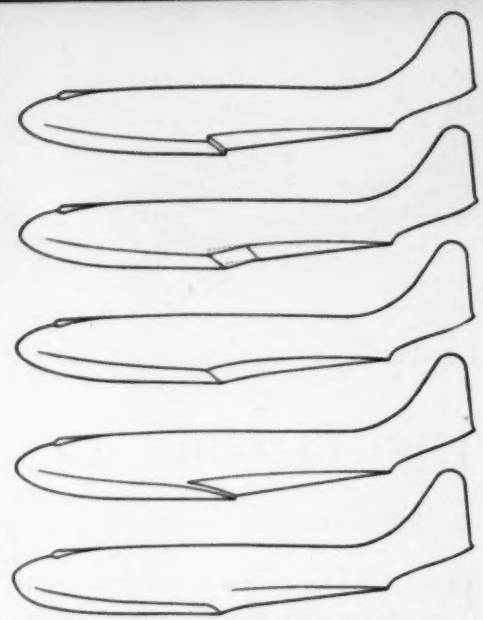
Spray strips, or plates attached to the hull at the forebody chine, had been investigated. Plates which projected horizontally from the chine had no effect on spray height and setting the plates at small negative angles to the horizontal showed no benefit; but plates at about 90 deg had proved successful. This was probably due to air flowing down the hull sides and aerating the mass of water leaving the spray strip in a downward direction, resulting in the aerated mass impinging with less force than normal on the local free water surface; consequently, the spray did not rise as high as usual. Spray strips parallel to the keel but at varying distances from the chine, had also been tried but were found to be less effective, the reduction in efficiency being proportional to their distance from the chine.

Most flying-boats in the past had shown some degree of fore and aft instability. This had been accepted, the experience of the pilot being relied upon to correct or check the onset of porpoising in its initial stages. Furthermore, since the various phases of instability were local to a narrow range of speed, it was frequently found that the aircraft accelerated through the region without permitting time for porpoising to develop. With the advent of high loadings and increase in unstick speeds it soon became evident that any form of instability was unacceptable since it could become uncontrollable, and the consequences were likely to be serious.

The types of longitudinal instability were roughly grouped as porpoising, skipping and pattering. Porpoising was a cyclic oscillation in pitch and heave and was the most dangerous type of instability, especially when it occurred at low trim angles. Tank experiments had indicated that trim and heave were out of phase, with trim usually leading. Two types of porpoising occurred, the first at low trim angles and the second at high angles. Low-angle instability was solely due to hull forebody design, except in the hump region. High-angle instability occurred at trims and speeds which nearly marked the configurations at which the afterbody entered the water; thus, it was dependent on the geometry of the afterbody and, in particular, the afterbody keel angle. If the upper limit were crossed at mid-planing speeds, the attitude was so high that the aircraft was usually thrown clear of the water and stalled on again, perhaps in a regular pattern. When it was thrown clear intermittently the motion was called skipping, which might occur both on take-off and landing, but more often on landing.

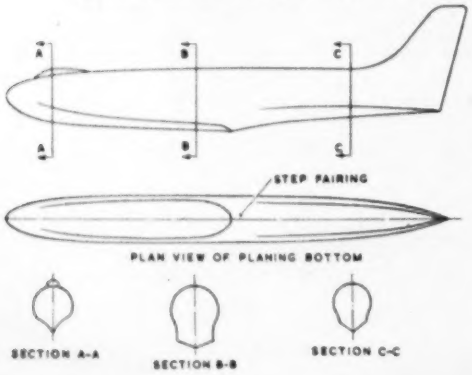
American tank testing had given experience of a second type of upper-limit instability. A model was trimmed up until porpoising occurred and the angle noted. The trim was then decreased until porpoising ceased and the angle this time was lower than previously, because the water clung to the afterbody after contact and did not break away until the latter had been pulled appreciably clear of the undisturbed trough.

If a craft met a disturbance in the hump region between the upper and lower limits, instability might occur, due to inadequate tail damping at these speeds. A second type of inter-limit instability, known as interference instability, was experienced with some aircraft at high speeds because the afterbody design did not allow free entry of air between the bottom and the trough. High suctions then occurred because the limited air supply was entrained and drawn away in the water faster than it could be replaced, so that the water intermittently stuck to the hull bottom.

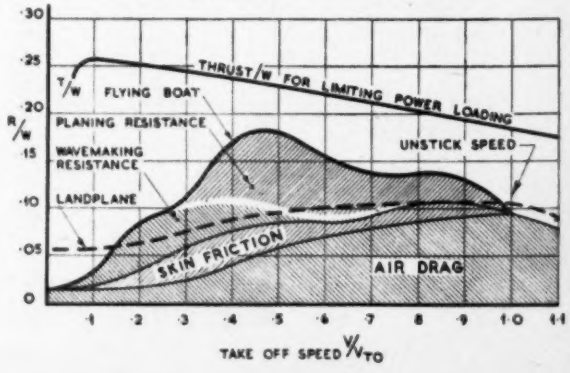


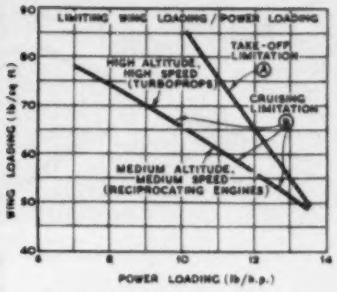
Examples of flying-boat steps. The second (reading down) is retractable; others are faired in varying degrees.

A refined hull-form with high length beam ratio. That chosen for the projected Duchess civil transport is very similar.



Showing how resistance at take-off is the sum of quantities due to air drag, wave-making resistance, planing resistance and skin friction.





Limiting power and associated wing loading, shown for various conditions of design.

Other types of instability that could occur included a small-amplitude skip just before take-off, due to spray from the forebody striking the afterbody. In the same period was encountered pattering, in which the afterbody appeared to remain just touching the water while the main step came clear intermittently. Inter-limit porpoising was not of great importance because aircraft normally accelerated through these regions before the motions had time to develop.

Mr. Knowler concluded this section of his paper with the remark that the present complete knowledge of what was in the past an obscure phenomenon made it possible to eliminate, by systematic tank testing, the various forms of instability which might occur.

Flying-boat hulls, he went on, were laterally unstable because their metacentre was below the c.g. The two common methods of securing lateral stability were the use of sponsons or lateral floats. A large number of successful flying-boats had been fitted with stub wings (or sponsons) but the view in the United Kingdom was that, although there were a number of advantages which could be claimed for them, the loss of efficiency due to extra drag and weight was too great a price to pay. Therefore, it was not expected that sponsons would have many advocates in the future.

Lateral floats could be of two types—those which were retracted into the wing tips and those positioned inboard. The inboard type had the advantage of being attached to a stronger part of the wing structure, but retraction was difficult, particularly as they were necessarily larger, because of their small moment arm. Nevertheless, retracting systems had been devised which permitted the complete retraction of the float and chassis into the wing. These retraction systems were costly in weight and when structural reinforcement in the neighbourhood of the wing recess was also taken into account it might be found that the total increase in structural weight was greater than the fuel weight saving made possible by the resulting drag reduction.

This argument did not apply in the same measure to floats which were retracted to the wing tips. These were smaller and the wing structure was not as seriously weakened by recesses. With wing-tip floats the effective aspect ratio of the wing was increased, and there was a beneficial effect from the floats acting as end plates. The improvement in induced drag in cruising flight went some way to compensate for the increase in profile drag.

It had been found from experience that some elasticity in the float-supporting structure was an advantage; thus a cantilever structure was suitable—a circumstance of some convenience when designing float retraction.

In discussing directional instability, Mr. Knowler said that recently, due to changed configurations and heavy loading, the problem had become important. Instability was usually worst at, or just before, the hump speed during take-off, but it could also occur during the landing run. The modern research instrument was the free-launching tank, in which dynamic models were catapulted into free gliding flight, from which they were landed under varying conditions of attitude and rate of sink.

Experimental evidence covering a wide variety of past and present designs, indicated that most hulls were basically unstable. This type of directional instability was caused by water flowing up around the afterbody sides and tail cone. It was aggravated by the sides overhanging the chines of the last third of the afterbody. By employing high length/beam ratios in present-day hull design the tail extension behind the second step could be eliminated and overhanging afterbody thus avoided. Associated with this improvement was the disadvantage of the greater controlling moment necessary with long hulls.

There were three methods of preventing or overcoming directional instability. These were by the use of (i) *Skeg*. This was simply an additional keel plate below the afterbody extending forward of the second step. If of sufficient size this was effective in curing directional instability. Its success was limited to the range of trims at which it would run in solid water. (ii) *Water rudder*. With jet-propelled flying-boats a water rudder was essential, as the possible offset thrust moment was small. With large aircraft it might be necessary to provide power assistance for its control. (iii) *Water flaps*. These were new devices equivalent to a split water rudder. The flaps were mechanically operated and combined the functions of water brakes and water rudder. They supplied powerful controlling forces, and it was claimed that, even in the most severe conditions, yawing could be counteracted and a directionally stable take-off could be made.

Concerning waves, the lecturer said that the technique of alighting in rough water was now better understood and this opened up the possibility of flying-boat use for duties which had not been considered possible in the past. For example, with a suit-

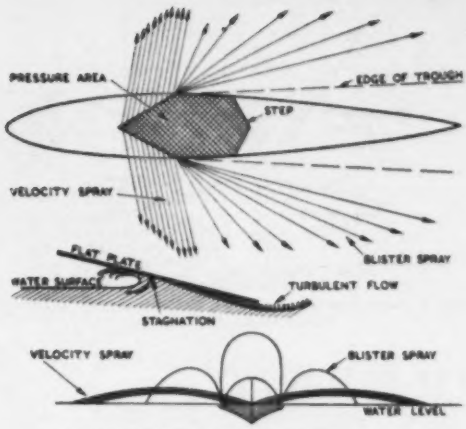
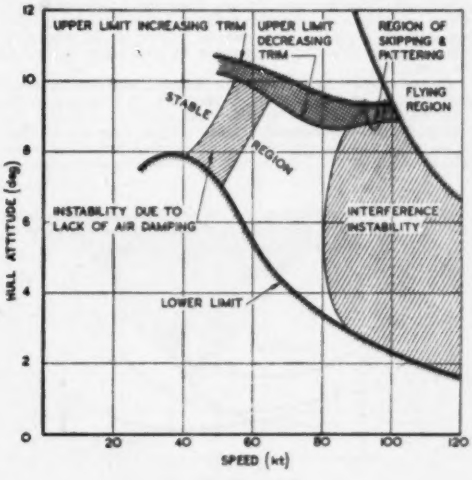
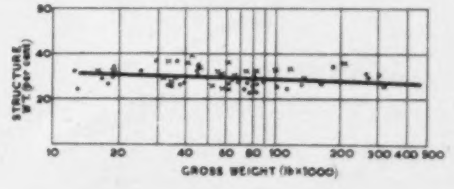


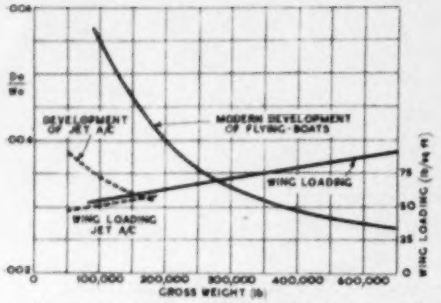
Diagram to show the propagation of spray.

Water-stability diagram—a plot of hull datum attitude against speed.

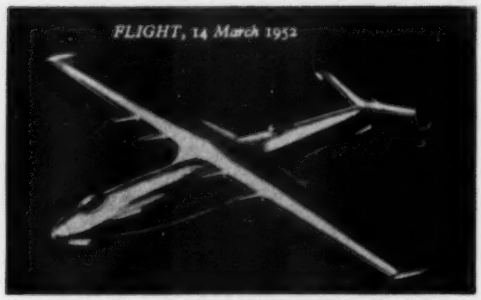


Statistics of structure-weight percentages covering the past ten years, indicating that the upward trend predicted from consideration of the "square/cube law" is not so far manifest. (× = flying-boat; • = landplane.)





Ratio of profile drag to all-up weight, plotted against the weight of modern designs of flying-boat.



Proposed design for an ocean-patrol flying-boat, weighing approximately 150,000 lb and powered with four compounded diesel engines.

THE FUTURE OF THE FLYING-BOAT . . .

able hull design it had been found possible to alight safely in seas up to 9ft from trough to crest.

A considerable amount of research information on accelerations and local impact pressures had been accumulated over many years, but recently the application of strain-gauging and the recording oscillograph had made it possible to measure transient stresses and accelerations with accuracy. Full-scale impact acceleration measurements had been made, using the latest form of instrumentation, both in calm and rough water, to check the magnitude of peak accelerations, and this had supplied data for comparison with theory. In the United Kingdom, as a result of joint investigation made by the Royal Aircraft Establishment, the Marine Aircraft Experimental Establishment and the Saunders-Roe Company, theoretical estimates of peak accelerations had been made which gave values agreeing well with full-scale results.

Mr. Knowler summarized his views on the subject of structural weight by remarking that there was so far no evidence to indicate when increase in size of aircraft, particularly flying-boats, would be accompanied by an increase in the structural weight percentage. Arguments had been advanced recently claiming that adverse scale laws applied to the specific power weight of turbine engines. This might be theoretically correct, but it was thought that technicians were following the same erroneous conclusions which has so effectively been refuted in connection with structure weight. This statement, it must be admitted, was based on a statistical examination of the subject, but the conclusion was clear that, taking into account the technical improvements which were continually being made, the specific weight of all types of engine showed improvement with increase in power. This was an important consideration in connection with the future of large aircraft. The fact that a growth in size did not entail a greater structure weight percentage did not alone justify large aircraft: the real justification arose from the gain in aerodynamic efficiency which resulted from increasing size.

Discussing maintenance and docking, the lecturer said that the tradition that flying-boats should lie at moorings for refuelling, inter-flight maintenance and loading died hard. His own views on types of base facilities were summarized as follows: (i) *Maintenance base.* All major overhaul work should be done at this base; therefore, it would have a slipway, hard-standing, hangars and stores. It would also have a number of permanent pontoon docks with all necessary supplies piped from the shore. (ii) *Operating bases.* All regular operating or refuelling points would be provided with a number of portable pontoon docks, having causeways to the shore carrying piped supply-lines for refuelling, electrical supplies and so on. They would, however, carry emergency equipment for engine changing. (iii) *Temporary refuelling bases.* These would be similar to the operating bases but would be equipped with a single portable pontoon dock. The dock would be used with either a floating causeway to the shore, where this was possible, with land-based refuelling storage and equipment, or from a barge moored nearby. (iv) *Emergency bases.* These would be used infrequently and need not be equipped with more than fuel storage and means of supply. The aircraft would lie to a mooring buoy and be tendered by a local launch. Fuel would be pumped from a small lighter.

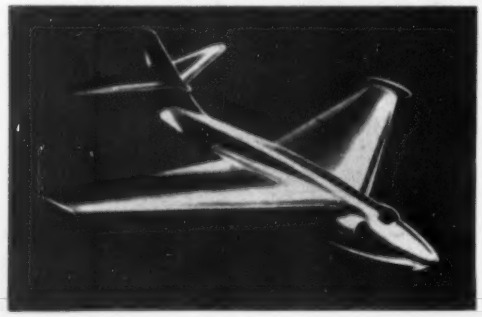
At this point Mr. Knowler looked further to the future. It would be apparent, he said, that hydrodynamic and technological development had made great strides in the past few years but, this knowledge had outstripped design application. To take full advantage of the flying-boat's unique facility for operation away from prepared bases special consideration must be given to ensure that the minimum of outside assistance was necessary for refuelling, rearming and inter-flight maintenance. By special design, the flying-boat's capabilities of landing on the open sea could be improved upon so that this possibility could be included in the military duties laid down. Long range was one of the flying-boat's most valuable assets, and increased range could be regarded as attainable on future classes of aircraft, including ocean-patrol boats and trans-ocean transports, both military and civil. These long-range types would almost certainly use airscrews.

Mr. Knowler now briefly discussed jet propulsion, turboprops and piston engines, and referred to the Napier Nomad, which consisted of a compression-ignition diesel, the exhaust from which drove a turbine coupled to an axial-compressor, which in turn supercharged the diesel. In addition, the surplus power from the turbine supplemented the main shaft output. This type of engine, he said, was particularly suitable for ocean patrol flying-boats, which were required to operate over a wide range of altitude and speed.

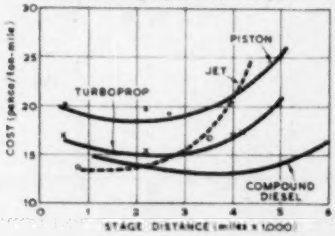
The operation of intruder/bomber squadrons from remote quarters of the world was now being considered. By the use of improvised bases the radius of action necessary could be reduced to distances which would permit the design to be primarily for speed, and with present knowledge, this might be in the transonic region. The water-based fighter had been brought into the field of military strategy and was capable of operation both from distant locations and also for home defence, where the indestructibility of the runways was a consideration in future defensive planning. The speed of this type of aircraft was not limited in any way by its water characteristics and machines in the supersonic class could be considered.

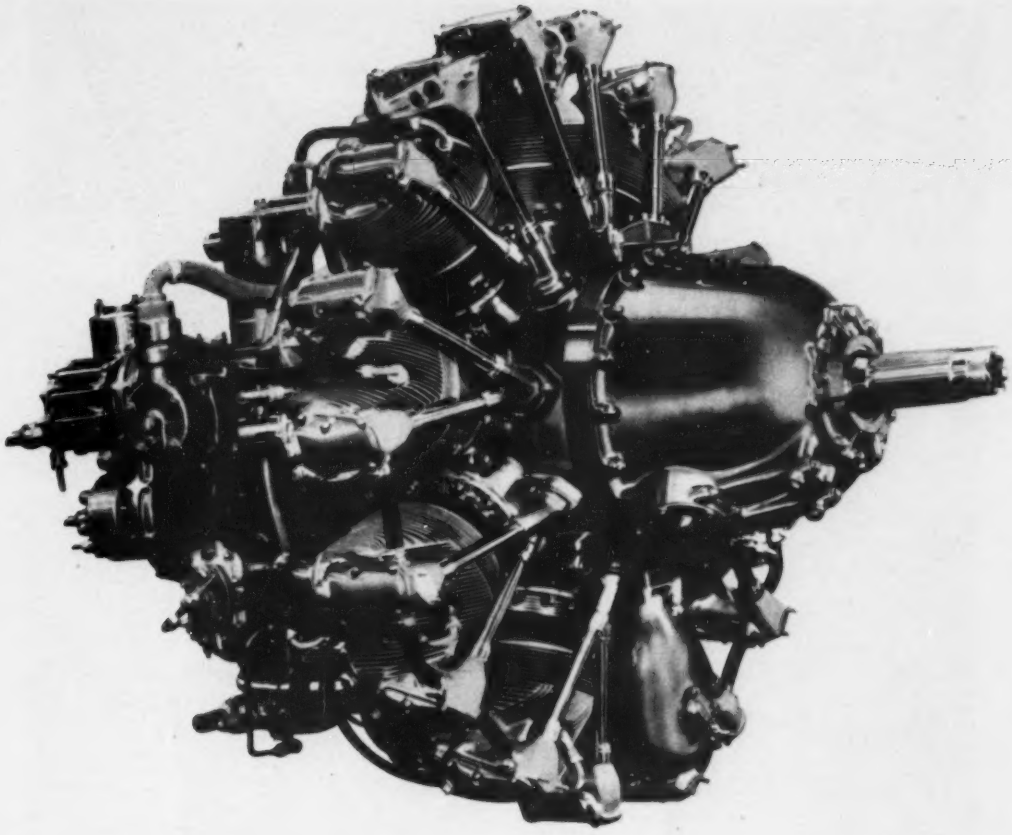
Of ocean-patrol flying-boats Mr. Knowler said that no doubt new methods of submarine detection would be developed in the near future, in addition to radar and sonobuoy location. For example, it had been suggested that such flying-boats should alight at sea, lying to a sea anchor, while sub-surface methods of detection were employed. This brought into prominence the high sea-

Design for a transonic intruder bomber flying-boat, described by Mr. Knowler as the logical development of aircraft such as the S.R./A.1.



Operating costs for different engines (no wind)—curves constructed for similar aircraft designed for optimum efficiency over varying distances, their size being adjusted accordingly.





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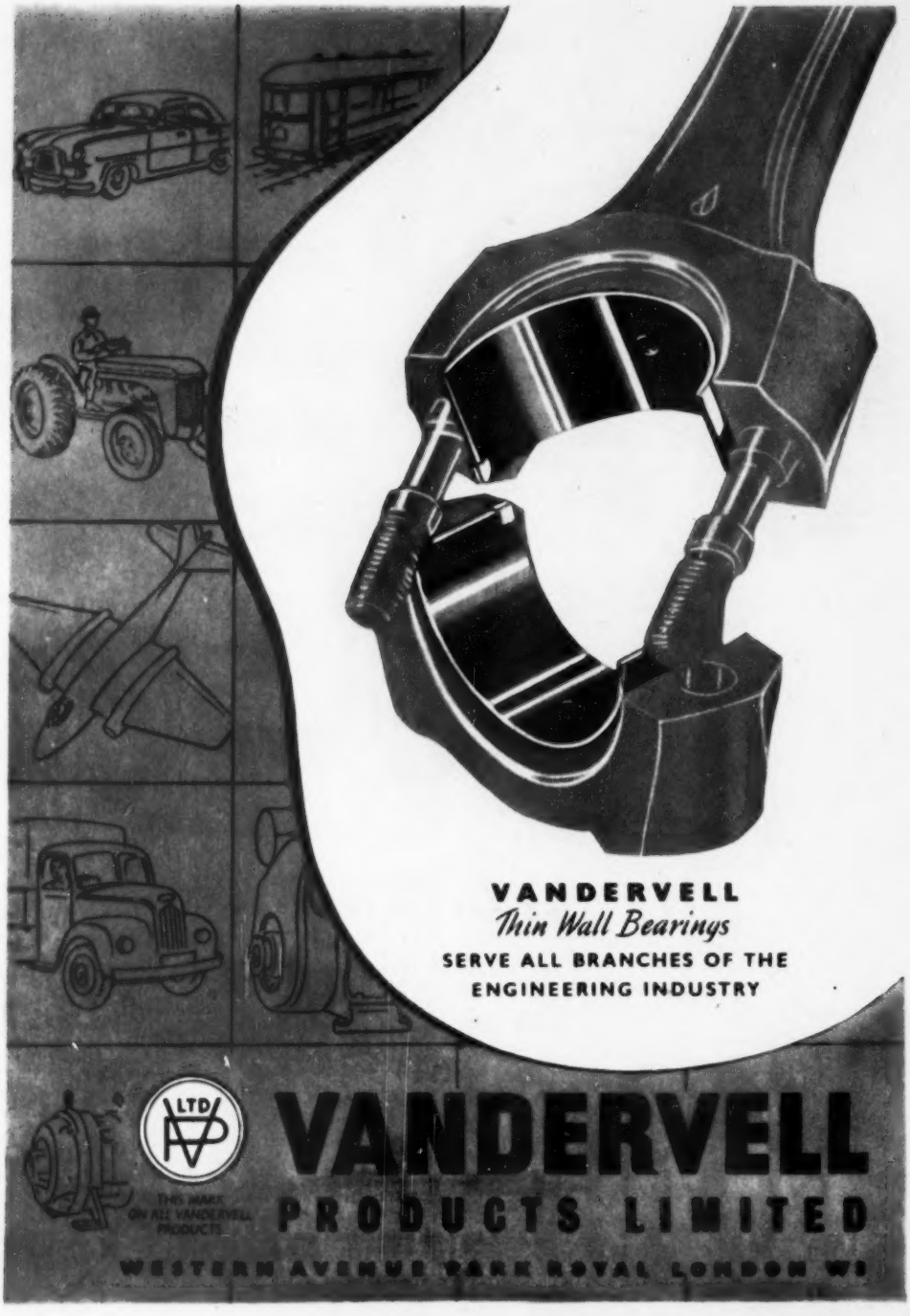
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Design for a pure-jet civil flying-boat—the Saunders-Roe Duchess.

Test model of a Consolidated-Vultee water-based fighter-bomber.

THE FUTURE OF THE FLYING-BOAT

worthiness which could be provided in future machines of this type. A hypothetical design considered would weigh about 150,000 lb and cruise at 400 m.p.h. for a gross range of 8,000 miles.

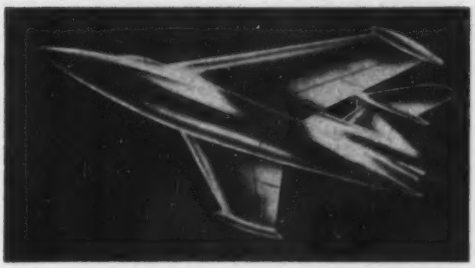
In looking to the future employment of flying-boats their use in the role of bombers and mine-layers should receive careful consideration. The problem of carrying bombs had been solved in a number of existing aircraft and new methods had been projected.

For troop-carrying there did not appear to be a case for a special military design, and it could be assumed that adapted civil aircraft would continue to be used for this purpose. Mr. Knowler briefly considered a special transport flying-boat with the main doors in the bows to simplify loading and render it possible to use the machine as an assault craft which could be run, bow first, on to a suitable beach. In future, the limiting factor in size would probably be the availability of engine power. There was also difficulty in efficiently converting high shaft power into thrust and for this reason the author set a limit to the upper rise in weight for some time to come at about 600,000 lb.

Mr. Knowler then went on to discuss commercial flying-boats and set out the qualities expected by passengers: (a) a smooth ride; (b) short-duration journey; (c) quietness, and (d) creature comfort. By reason of its size and the use of turboprops, which were most economical at high altitudes and relatively high speed, the Princess satisfied in most respects the qualities enumerated. The availability of turbojets had turned thought to the possibility of high-speed medium-range transports. It was shown that for medium ranges the pure-jet aircraft could be a better economic proposition than an airscrew-driven machine, and it was thought that the jet-propelled passenger aircraft would eventually become universal for stage distances of 1,000-2,000 miles. The lecturer discussed a flying-boat project (obviously the Duchess) which represented a type of the immediate future and had been designed to operate on stage distances of about 1,500 miles at a cruising speed of 450 m.p.h. Maximum take-off weight was 130,000 lb and the machine was to be fitted with six de Havilland Ghosts. This power plant met the specified requirements well, and though other units were available with lower specific consumption, these had greater power, and the size of the aircraft, in order to obtain similar operating costs, would have to be increased. Furthermore, the larger aircraft would show its best economy over a greater stage distance than that actually required by the specification. There did not appear to be a great gain in operating a passenger aircraft with a higher cruising speed than 500 m.p.h., and it was probable that future development would be in range and size.

Study of the S.R./A.1 flying-boat fighter suggested that in a later generation of fighters a radical change in outlook was necessary if the performance was to compete on equal terms with a land-based fighter, and the conclusion had been reached that no concession could be made during flight to hydrodynamic requirements. It was clear that the conventional flying-boat hull, even with the most modern refinements, must be discarded and other means found to provide satisfactory water behaviour. Saunders-Roe had designed a high-speed water-based fighter in which hydro-skis were used. Although capable of taking off from water, the machine was no longer a flying-boat in form and, when in flight, was on equal terms with the equivalent land-based aircraft. In this design the turbojet intake was above the fuselage in the form of a pitot entry which had been developed in the wind tunnel to give high overall efficiency.

Before concluding, Mr. Knowler had some interesting observations to make on atomic-powered flying-boats. It had recently been announced in the United States, he remarked, that work had been initiated on an aircraft deriving its power from nuclear fission. The use of this form of energy opened up possibilities for long-range operation hitherto undreamed of, but consideration of its ultimate uses were profitless at this stage and it was proposed to confine discussion to its initial application, which might well be associated with a flying-boat.



Saunders-Roe proposal for a water-based fighter. The intake—in the form of a pitot entry—is located above the fuselage.

So far there was no clue to the nature of the reactor being developed, nor the method of converting the energy into thrust, but it was probably safe to assume that only the heat energy of nuclear reaction could be used and, further, it could be inferred that vapour-driven turbine engines with airscrews would form the power units, at least in early installations.

The weight of reactor unit, controls and screening would be high; this part of the installation took the place of the fuel load in the conventional aircraft. A very approximate approach to the aircraft weight indicated that for structure, engines, take-off assistance and useful load, roughly 60 per cent of the total weight would be required. Therefore, for a reactor unit weighing, say, 100 tons, an aircraft of from 500,000 lb to 600,000 lb weight would be necessary. This was a very big aircraft to contemplate as a landplane but as a flying-boat such a size would be acceptable without query.

The atomic-powered aircraft would cruise at constant weight and power throughout the flight, and it could be assumed that, for economic reasons, the cruising power would approach the maximum of which the plant was capable. As a consequence, for take-off and initial climb, assistance from some other form of energy, such as liquid rockets, would be necessary. In order to reduce power assistance as much as possible it would be wise to make the take-off from water, where runway length was unrestricted.

Since the weight of fuel consumed was insignificant, the design optimum aerodynamic conditions should prevail throughout the flight, and the unusual condition was met in which the take-off and landing weight were the same. The possibility of landing flying-boats at their take-off weight had always been recognized as an acceptable manoeuvre. The unobstructed approach run, unrestricted landing area, and short run after touch-down, reduced the landing hazard, and the shock-absorbing properties of a Vee bottom ensured low landing accelerations.

The opinion had been expressed that turbine-driven airscrews would be used. This did not necessarily restrict the performance to subsonic speeds since supersonic airscrews would soon be available; but it was thought that for an aircraft capable of very great distance, and in order to limit accelerations developed in disturbed atmospheric conditions, the cruising speed of the first atomic aircraft would be subsonic.

This last subject, Mr. Knowler said, was an appropriate one on which to close his lecture. The end of the first half-century of flight now approached, and throughout this period aviation had been developing so rapidly that at any given time an aircraft just newly flown, because of the gain in knowledge acquired since its inception, had already become virtually obsolete. The surprising thing was that this state of affairs held today as much as in the years past.

MAN without GRAVITY

The Physiological and Psychological Problems of Space-flight

By L. N. THOMPSON, B.Sc. Hons.Eng., G.I.Mech.E.

AT first derided, but in recent years accorded serious consideration and study by men of science the world over, the subject of space-flight opens up awe-inspiring possibilities. Much has already been written about the projected design and operation of space-ships; but, outside the journals of the specialist societies little has been said of the possible effects on crews who will man them. In this article some of these implications are discussed, and make fascinating reading—as, for example, that since free liquids under conditions of zero g will coagulate into spheres floating in the cabin air, drinking will be difficult . . .

Mr. Thompson was recently awarded the T. Bernard Hall Prize of the Institution of Mechanical Engineers, for his paper entitled "Fundamental Dynamics of Reaction-Powered Space Vehicles."

SINCE the official announcement by the United States Government, in 1948, of the existence of the E.S.V. ("Earth satellite vehicle") programme, world interest in the subject of interplanetary travel has increased, and the engineering aspects of space-flight are now almost a commonplace topic of discussion among the world's leading engineers and scientists.

While the more spectacular engineering side of space travel has received considerable publicity, relatively little has been said about the physiological and psychological aspects of the problem. It is possible, however, that in the long run the medical problems of space-flight may well prove a greater stumbling-block than the purely mechanical considerations, and for this reason the work being undertaken by the U.S.A.F. Department of Space Medicine is of particular interest.

The Department of Space Medicine was set up at Randolph Field, Texas, in 1949, as part of the organization of Rand Corporation, who are sponsoring the Earth Satellite Vehicle Programme under the general co-ordination of the Committee on Guided Missiles, Joint Research and Development Board. The Department is an extension of the Air Force's School of Aviation Medicine, and was formed to investigate the medical effects of weightlessness, acceleration, radiation, etc., on the crews of future artificial satellites and rocket ships. Apparatus used in these investigations includes such items as the U.S. Navy's five-million-dollar 50ft radius centrifuge, which is capable of developing accelerations of up to 40g.

One of the first steps towards the achievement of interplanetary travel will very probably be the establishment of artificial satellites rotating in close orbits about the earth. The orbits of these artificial satellites will lie completely outside the terrestrial atmosphere belt in order to eliminate all air drag, and under these conditions the satellites will remain permanently in orbit, as the centrifugal force due to the orbital motion will exactly balance the earth's gravitational attraction.

Similarly, however, the weight of any human crews inside these artificial satellites will also be cancelled out, i.e., zero gravitational potential will prevail. These same conditions of zero g will also occur inside a space-ship when it is in free fall, that is, moving in a vacuum with the rocket motors shut off.

Essential Knowledge

As large, manned, artificial satellites, termed "space-stations," will have permanent crews, and as actual interplanetary journeys to the other planets of our solar system may necessitate months spent in free fall between home and destination planets, it will obviously be of great importance to know beforehand what physiological and psychological effects the absence of gravity, both for short and long periods, is likely to have on the human body.

The answer to this problem will not be known definitely until the first experimental artificial satellites are placed in orbit about Earth, and long-term investigations have been carried out by their volunteer crews; but a fair idea of the effects to be expected can be obtained from a consideration of the bodily functions which make use of gravity.

Functions such as breathing, heart action and eating, are primarily muscular in nature; it is found that very few physical processes and organs make direct use of gravity. The only exceptions to this appear to be the balancing organs, both the labyrinths of the inner ear and the sensory organs of the body itself. However, even the ear labyrinths are apparently not wholly dependent on gravity for their operation.

The balancing organs of the inner ear are primarily constituted by the canals and vestibular organs. Each labyrinth contains three semi-circular canals mutually at right angles, these canals being filled with a fluid and partially blocked at one end by a sensory organ named the ampulla. When the head is moved in any direction, the mass inertia of the fluid (note that this is not the weight of the fluid, as weight is mass inertia multiplied by the prevailing gravitational potential) causes it to tend to lag behind in the canals. In consequence, the fluid pressure on the respective ampullæ is either decreased or increased, and the ear nerves transmit corresponding information to the brain, regarding the rate of change of movement of the head.

It therefore seems apparent that the semi-circular canals depend for their operation primarily on the mass inertia of the fluid and not on its weight. As the mass inertia will be unaffected by variation in gravitational potential, no malfunctioning of the semi-circular canals should thus be occasioned by conditions of zero g.

However, the other balancing components of the inner ear, namely, the vestibular or otolith organs, would appear to require a gravitational field for their normal operation. In the human inner ear there are two types of these otolith organs, the utricle and the saccule. Each consists of a small cavity covered on one side with a cellular layer, the macula, from which tiny hairs project. These hairs in turn support in the cavity interior a jelly-like layer in which are embedded many minute crystalline particles known as otoliths or earstones.

With the head in the normal upright position, the macula of each utricle is horizontal and at the base of the otolithic cavity, while the macula of each saccule is vertical. The weight influence of the tiny otoliths appears to be transmitted by the hairs to the maculæ, and hence to the nervous system of the inner ear. Depending on the position of the head, therefore, the weight of the otoliths apparently exerts a varying influence on the maculæ, and hence varying nerve signals are sent to the brain, thus supplying information regarding bodily balance.

As these otolithic organs therefore seem to require weight for their operation, it is consequently debatable what nervous impulses will be transmitted from them to the brain under conditions of zero gravity. Some experimental evidence appears to indicate that under such conditions conflicting impulses would be transmitted by the different otolithic organs, but the question is one which cannot be answered definitely until true conditions of zero g are available for research purposes.

In addition to utilizing the balancing organs of the inner ear, the human body also orientates itself by means of both vision and the bodily sensory organs, particularly those in the muscles. These

As illustrated in the recent film, "Destination Moon," in which this scene appeared, acceleration couches to support the whole body against high g forces may be a feature of manned-rocket furnishing.

This photograph, again from "Destination Moon"—a film carrying unusual scientific conviction—shows the man as being weightless (i.e. in free fall); he is holding two pairs of magnet-soled boots.

derive their action by registering the tensions, weights, and bending moments acting on various parts of the body in various postures, and therefore appear in some measure to require gravity for their functioning.

This conclusion is borne out by the fact that persons immersed in water (when their bodily weights are cancelled out by the buoyancy force of the water) can orientate or balance themselves only if they can see. It is, therefore, evident that the balancing organs of the inner ear are not in themselves sufficient to maintain bodily balance.

Further evidence of this latter point is afforded by observations made on deaf mutes, in certain of whom some of the inner ear balancing organs, such as the otoliths, do not function. It has been found that such deaf mutes can still balance themselves under water as long as they can see. In addition, in tests made on laboratory animals which have been suddenly deprived of their ear balancing organs, the animals appear soon to recover from the effects of this deprivation and to be none the worse off from the balancing point of view, so long as they can still see.

It therefore seems that the visual sense alone is sufficient to enable balance to be maintained. As zero g will not in general affect vision, space travellers will quite probably be able to orientate themselves satisfactorily by the use of their eyes alone.

If long periods of zero g are anticipated, however, it will almost certainly be desirable, from the point of view of crew comfort, to provide some measure of artificial gravity by means of rotating the satellite or ship about its central axis, hence creating a centrifugal force. This artificial gravity will also facilitate operations such as eating, drinking, and air circulation, although, as previously mentioned, gravity is not absolutely essential in these functions.

Free liquids under conditions of zero g would coagulate into spheres floating in the cabin air, as surface tension would be the only force acting upon them. Liquids in such a condition would obviously be rather difficult to swallow, and hence artificial gravity will be helpful.

Also, the absence of gravity will render the cabin air weightless, and unless some mechanical system of forced circulation is provided, no air currents will flow, as hot air will no longer rise. In consequence, a person remaining in one position could suffocate in his own products of lung respiration, and flames would choke themselves out with their own products of combustion (unless the fuel contained inherent oxygen). Photographs of a candle flame in a free-fall chamber show that the flame first becomes spherical and then gradually dies out. Fire hazards in space-stations and space-ships without artificial gravity will be negligible.

An alternative to centrifugal force as a means of creating artificial gravity, particularly for short periods, would be the use of magnetic clothing by the crews. It will be recollected that in the film *Destination Moon* the space-travellers made use of magnets attached to the soles of their space-boots. This film also contained some striking scenes illustrating the effects of weightlessness on the crew members after escape velocity had been attained.

In addition to these medical problems created by the absence of gravity, further physiological problems are raised in the other extreme by the greatly increased gravitational effect caused by the acceleration of a rocket-ship during take-off from earth's surface. For ships leaving Earth, it will be advantageous from the engineering viewpoint to have the take-off acceleration as high as possible within a certain upper limit, this limit being when the advantages of reduced fuel expenditure due to high accelerations are just balanced by the increase in structural weight necessitated by these high accelerations.

The effect of this high acceleration on the crew will be greatly to increase the weight of all components of their bodies. For example, with a 3g vertical take-off, i.e., a rocket upward acceleration of approximately 100 ft/sec/sec, a body will weigh four times its normal weight, as to the normal weight at rest will be added the triple weight due to the 3g acceleration.

Manned, Earth-based space-ships may be required to take off at as much as 3g or 4g, which amount is often sufficient to cause crew black-outs. (It is of interest to note that while such accelerations or decelerations have deleterious effects when prolonged for relatively long periods, much greater amounts can be safely borne by the human body for very short periods. For example, in tests carried out with manned rocket-propelled sleds by the U.S.A.F. at Muroc Dry Lake, California, decelerations of up to 35g for less than one-fifth of a second were withstood by the occupant without harm.) Remote radio control of the ship during take-off might therefore be necessary, as, even if the crew did not black-out, their greatly increased bodily weights would tend to prevent them from handling controls with anything like a satisfactory degree of dexterity.

Well-sprung horizontal acceleration couches will very likely be provided for the crew members, the horizontal position helping to prevent the brain being starved of blood. Even with a horizontal posture, however, black-outs will still occur at a certain critical acceleration, when the weight of the blood is so increased that the heart can no longer keep it circulating through the arteries and veins.

Radiation Protection

The cumulative physiological effects of repeated black-outs will also have to be closely investigated if space-ship design eventually turns out to require accelerations so high that black-outs become a regular occurrence. However, high accelerations are likely to be necessary only with ground-to-orbit ferry rockets operating against Earth's powerful field. Ships accelerating from sub-orbital equilibrium velocity to escape velocity will be firing tangentially (at right angles to the g-field) and hence the efficiency of their operation will be independent of high accelerations. Physiologically suitable low accelerations will therefore be quite permissible for such ships, and these low accelerations will be particularly welcome from the engineering aspect also, as they will allow the use of light rocket structures and the possible use of such devices as low-thrust electronic ion-beam space-drives, the developed thrust of which will be much less than the deadweight of the ship itself.

A hazard facing the space-travellers of the future will be the radiation permeating all interplanetary space. Earth's surface is shielded from the harmful effects of this radiation by the thick blanket of the atmosphere, but out in space the full intensity will be experienced without alleviation.

Considerable research work will therefore have to be undertaken to ascertain the effects of this unshielded radiation on human beings. Partly to this end, test firings of very-high-altitude (up to 250 miles) rockets fitted with radiation-, pressure- and temperature-measuring devices have for some time now been proceeding at White Sands, New Mexico. Some of these rockets have contained insects such as fruit flies to determine what mutation effects, if any, the cosmic radiation has on them. In the future, no doubt, laboratory animals such as guinea pigs will be similarly exposed to the radiation, and eventually human volunteers will ascend in rockets for the same purposes.

This space radiation is of many types—heat, ultra-violet, X and cosmic rays, etc. The cosmic radiation entering our solar system from outer space, with its source and origin uncertain, is at present one of the great enigmas facing science. It is generally assumed to be caused by matter being either created or annihilated in other galaxies of the Universe. The achievement of space travel, and hence the possibility of studying this radiation from outside the atmospheric belt, will almost certainly assist towards a solution of this problem, as the nature of the cosmic radiation at earth surface will differ from its free-space nature, due to the collisions the ray particles make with air molecules during their passage through the atmosphere.

In similar fashion, a great percentage of the ultra-violet radiation given off by the sun is stopped by the atmosphere. This

MAN without GRAVITY . . .

radiation in its concentrated form would cause intense sunburn. The steel hull of a space-ship, or even the glass of any portholes it may have, will be sufficient to shield the crew from ultra-violet, but much more efficient shielding will be required to inhibit the highly penetrative cosmic rays. Thermal control of the ship will probably be achieved by using a thick, insulated hull having outer surfaces which have been silvered (to reflect heat), or blackened (to absorb it). A refrigerating system could also be installed if found necessary.

Some unique air-conditioning problems will be encountered in the design of artificial satellites and space-ships. In addition to the previously mentioned effects of zero gravity on air circulation, the crews may in some instances have to exist in artificial atmospheres for very long periods at a time, and it is by no means certain that these atmospheres will be physiologically satisfactory over such periods. For example, if oxygen, either pure or diluted with other gases, is breathed continuously for periods of up to several weeks, adverse physical symptoms may develop.

However, this problem of air-conditioning will almost certainly be capable of solution along fairly standard lines, and can probably be regarded as one of the minor problems of space-flight.

The possibility of infection by alien viruses and germs on other planets will also have to be closely guarded against by the first men to reach these planets. Germs may exist there against which the human body has no defence, and it would be ironic if, after the greatest engineering achievement of all time, the expedition should be destroyed by unknown germs.

It may in fact be necessary for the first landing expeditions to stay inside their ships for a considerable time after landing, in order to allow some preliminary general analysis of the outside conditions to be made, before even space-suited explorers venture out. (In passing, it may be noted that these space-suits would probably have to be designed specifically for operation in one particular location, as suits suitable for conditions on one planet might be quite useless on another. For example, a suit designed for use in the hot, carbon-dioxide atmosphere of Venus would probably be of little value on, say, the virtually airless Moon, where the temperature fluctuation is very great.)

Even more serious is the possibility that some virulent plague may be carried back dormant to earth by the returning ships, and then break out in its full violence after landing. Some form of rigorous quarantine will very probably have to be imposed on returning space-expeditions.

Finally, the psychological effects of space-flight must be considered. It is probably fair to say that these will be much fewer, and of less importance, than the purely physiological repercussions.

During long flights, such as the journey from Earth to Mars, the crew of a space-ship will be continually confined inside the relatively small life-chambers of their ship for many months at a time, and during this period the crew will have very little to occupy them. It will, therefore, be essential, when selecting the crew, to choose persons who have previously proved to be very stable emotionally and who will not be likely to suffer from psychological complaints such as monotonic neurosis and claustrophobia, due to the long confinement, or cumulative anxiety neurosis, due to living under the conditions of permanent stress occasioned by the actual and potential dangers of space-flight.

However, unlike many of the physiological troubles, these psychological problems should largely be capable of solution on earth. The great mount of practical experience obtained during war-time with similar problems will be invaluable in this respect.

Mock-ups of space-ship cabins could be constructed on earth and the chosen crews enclosed inside them for long periods to check their reactions. The past records of the crew members will also give a good indication of their individual general psychological make-up and stability under stress.

It will be of very great importance to ensure that the living conditions of the crews on these long flights are as comfortable as possible, for the psychological state is highly dependent on the physiological. As is well known, bad and uncomfortable living conditions, when endured over long periods, can produce a psychological crisis, even though a short period of such conditions can safely be borne without critical stress.

For this reason, some form of artificial gravity within the ship will be very desirable, as previously mentioned, and the air-conditioning and thermostatic control of the cabin will have to be of a very high standard.

In conclusion, we see that the medical problems raised by the advent of space-flight will be of a very diverse character indeed and that some of them will be unique in medical history. Considerable progress towards their solution will be made by future terrestrial research, but the final complete answers will not be known until, during the next few decades, the first giant ships of Earth hurtle out into the interplanetary void.

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DEFORMATION CRASH-SWITCH

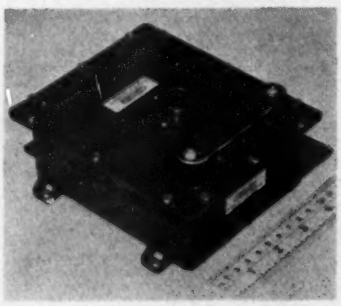
AUTOMATIC safety-devices for aircraft, actuated by the conditions obtaining in a crash, have previously largely relied upon the deceleration experienced upon impact. By contrast, a new crash-switch developed by the Graviner Manufacturing Co., Ltd., of Colnbrook, Bucks, is actuated by small deformations of a sensitive element placed in prominent positions on the underside of the airframe.

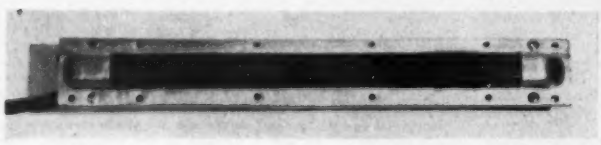
This element, shown in the accompanying photograph, consists of a strip, of any desired length, moulded from synthetic rubber and containing three spring-steel strips which are separated mechanically and insulated electrically by staggered pads of synthetic rubber. A pre-determined pressure applied to any portion of the element results in electrical contact being made across the strips.

In a crash at high speed, there is a possibility of such an element being torn from its mounting before the aircraft automatic systems could function; such a contingency has been guarded against by the insertion of a simple condenser and high-speed relay in the operating circuit. This has resulted in the circuit having an operating time of but 40 microseconds—equivalent to $\frac{1}{10}$ in of forward travel at 250 m.p.h. It is claimed that the possibility of failure of the switch is remote, especially since installations visualized include lengths of not less than a foot of sensitive element mounted in the direction of the line of flight of the aircraft.

The switch is to be tested, in the first instance, upon an aircraft catapulted on to the ground, giving an approximation to typical crash conditions. This aircraft will be fitted with five strips on its lower surfaces, each strip being wired to a separate relay box. Each relay box will in turn be wired to a photo-flash bulb, the five bulbs being mounted prominently on top of the fuselage. From ciné camera records it is hoped to be able to obtain an indication of the duration of contact of each sensitive strip with the ground by lining-up the flash from each bulb with the concurrent aircraft attitude.

Representative weights of the equipment, at the present stage of development, are 4½ oz per foot run for the strip (with aluminium attachment flanges) and 1 lb 8 oz for a relay box into which a representative number of strips could be fed.





The switch and (below, to a slightly larger scale) a typical sensitive element.

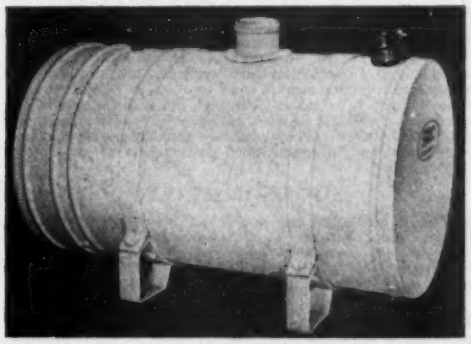
THE INDUSTRY

Air of Comfort

THOSE who read our recent notes (January 25th) on the equipment of the Bristol 175 will have been impressed by the very comprehensive nature of the air-conditioning equipment installed. Humidifiers form an important part of such installations; and that they call for carefully thought out design is apparent from a description of those which the General Electric Co., Ltd., are supplying for the Type 175 or Britannia fleet.

Steam from the electrically heated boiler of the unit may be fed into the cabin air supply at any convenient point, and a 2-in dia. steam pipe is provided for making the necessary connection. Water is pump-fed into the boiler through a float chamber which automatically maintains the correct level by actuating a micro-gap switch in the feed-pump circuit. If a failure in the feed causes the level of the water in the float chamber to fall, a second micro-gap switch cuts out the heating elements. The humidifier unit is intended to be controlled by a humidistat so as to come into operation when the relative humidity falls to 25 per cent, and to cut out when it rises between 60 and 70 per cent.

The boiler, with a capacity of approximately 1¼ gal, has ten pocket-tubes mounted in a removable plate. Each tube accommodates one 750 W cartridge-type element, thus giving a total loading of 7.5 kW. The design of the unit is such that by varying the number of heating elements, any desired loading up to 7.5 kW may be arranged. Also, by increasing the overall length of the unit slightly, the total loading may be increased to 10 kW.



The latest G.E.C. cabin humidifier, described here.

Heaters for supply voltages ranging from 112 V to 250 V A.C. or D.C. can be accommodated. The quantity of steam generated by the 7.5 kW unit is approximately 19½ lb/hr, while for the 10 kW loading about 26 lb/hr is produced.

The humidifying unit weighs 32 lb, and its overall dimensions are 18¼ in long by 10¾ in high.

Light-alloy Quality Control

A NEW system of metallurgical quality control, recently introduced into this country, enables two men to carry out in one hour an analytical process that formerly was a day's work for six. It is now possible to complete an accurate analysis for up to 13 elements in less than four minutes.

In the production of high-grade aluminium alloys, the alloying elements must be controlled to close limits. Previously the time factor has made it necessary to verify the composition after the metal was cast; if it failed to meet specification requirements it had to be rejected for re-melting. With the method now in operation at the T.I. Aluminium, Ltd., foundry at Resolven, near Neath (South Wales Aluminium Co., Ltd.), the speed with which results are obtained permits the checking of the metal in the furnace before it is cast. In operation, therefore, the exact analysis of every slab or billet is known prior to casting, assuring continuity of quality and smoother production flow in the rolling and extrusion mills.

The new technique depends on the use of a complex apparatus known as the A.R.L. Production Control Quantometer, which is an electronically operated form of direct-reading spectrograph. The three principal components are a source unit for exciting an arc, or spark, from the metal to be analysed; a spectrometer for measuring the relative intensities of the light wavelengths existing in the arc; and a recording console giving direct interpretation.

NEW POSTS AT BELFAST: As we recorded last week, Short Bros. and Harland, Ltd., have recently made a number of staff re-appointments. Mr. P. S. Lewis, A.F.R.Ae.S. (left) becomes superintendent of research and development; and Mr. R. Beaney, A.F.R.Ae.S., formerly assistant designer, takes charge of the experimental department.

Mond Nickel Fellowships

THE Mond Nickel Fellowships Committee invites applications for five Fellowships of average value of £750 each for 1952. These Fellowships will be awarded to selected candidates of British nationality, with degree or equivalent qualifications, to enable them to obtain wider experience and additional training in industrial establishments, at home or abroad, of a kind to fit them for future employment in senior technical and administrative positions in British metallurgical industries. Each Fellowship will cover one full working year. Applicants will be required to state details of the programme they wish to carry out. Particulars and forms of application are available from : The Secretary, Mond Nickel Fellowships Committee, 4 Grosvenor Gardens, London S.W.1. Completed application forms are required by June 1st, 1952.

For Inner Cleanliness

A NEW additive for use with aviation petrol was recently discovered simultaneously by two teams of Shell scientists working independently in Britain and America. The additive is a chemical—tricresylphosphate—and is so effective in countering lead deposition that (it is suggested) non-scheduled spark-plug changes may be cut by as much as 90 per cent.

Tetra-ethyl-lead is a normal constituent of most aviation petrol, for it effectively raises the octane rating of basically lower-grade fuel. It is not, however, generally realized that the amount of lead passing through a large piston-engine is considerable; for example, the tetra-ethyl-lead consumed in a 1,200 h.p. engine during 1,000 hours' running is the equivalent of about half a ton of metallic lead. Most of this is, of course, exhausted with the products of combustion, but nevertheless some remains and causes fouling. The use of tricresylphosphate will, it is thought, increase the life of plugs and valves many times over. All that now remains, it seems, is to discover some means of reclaiming the valuable lead from the exhaust gases!

AT THE HUB: G/C. E. Pinto, Air Adviser to the High Commissioner for India, recently visited the Bristol Aeroplane Company's works. Seen here discussing a Type 171 rotor head in the helicopter department are (left to right) Mr. E. Thursby (B.A.C.), W/C. Hickey and W/C. Lal (Assistant Air Advisers), G/C. Pinto and Mr. Colin Harvey (B.A.C.).

THE AERONAUTICAL BOOKSHELF

Undramatized Drama

"The Happy Valley," by Jules Roy. Victor Gollancz, Ltd., Henrietta Street, London, W.C.2. Price 12s. 6d.

HAPPY VALLEY was Bomber Command's ironical war-time nickname for the Ruhr; and this book describes the 1944-45 activities of a Halifax squadron whose targets ranged over this formidably defended area and Northern France. Its crews were all French, and the author, who served with the R.A.F., gives such a graphic and moving picture of their experiences and feelings that the reader soon identifies the hero Chevrier with Jules Roy himself, and begins to realize that this "novel" is 99 per cent fact.

We know of no other writer who has so vividly conveyed to his readers the worst terror of many bomber crews during mass raids—the fear, not of being hit by enemy fighters or flak, but of being rammed by a colleague while flying almost wing-tip to wing-tip and nose to tail in the great stream of Halifaxes and Lancasters cruising in darkness to and from their distant targets and circling their massed airfield bases mainly in Lincolnshire and Yorkshire.

Yet it is unlikely that more than a small proportion of the aircrews lived with fear every hour of the day and night as Chevrier seems to have done. In fact, few who suffered from his intense forebodings—and, off duty, his loneliness—would have been able to continue. Horrifying though the casualty rate undoubtedly was, the worst period had been experienced some months before the raids described in this book. On the whole, members of bomber crews tended to fear more for their fellow crewmen than for themselves; as their operational experience grew, so, often, did their personal optimism about their own immunity from trouble.

The beauty of Roy's prose (admirably preserved by the translator, Edward Owen Marsh) rivals that of St. Exupéry; equally important, as Air Marshal Sir Robert Saundby comments in his foreword: "There are no exaggerations, no piling on of horrors, no false dramatization"—nor, one should add, the usual excessive "love interest," although there is a girl whom Chevrier sometimes visits during his leaves. No book has given a better idea of how much we owe to the men of all countries who waged Bomber Command's ceaseless battle for more than five long and terrible years.

Basically Evil

"Marshal Without Glory," by Ewan Butler and Gordon Young. Hodder and Stoughton Ltd., Warwick Square, London, E.C.4. 287 pp. Illustrated. Price 15s.

A NATIONAL newspaper recently asked its readers what they would do if they discovered that Adolf Hitler was still alive and living as their next-door neighbour. More than half of those who replied admitted they would keep his secret if he appeared to have become a decent, law-abiding citizen.

We could not avoid thinking of this as we read *Marshal Without Glory*, a new and excellent biography of Reichsmarschall Hermann Goering. The authors have uncovered many new details of the life of this incredible man; but despite Lord Justice Lawrence's verdict at Nuremburg that "Goering's guilt is unique in its enormity," one wonders if, five years later, when half our people are prepared to give Hitler another chance, Goering would still be condemned to death by a war crimes court.

There seems almost more justification for Hitler's last crazed order for Goering's execution, for, although the Reichsmarschall remained faithful to his Führer to the end, there is little doubt that his gradual mental and physical deterioration contributed greatly to Germany's downfall. In *Marshal Without Glory*, we read how Goering, in February, 1940, stopped all work on such advanced designs as the Me 210, 309 and 262, the Ta 152, He 177 and Ju 188, in favour of mass-production of already outmoded existing types. Similarly, he suspended work on the "FX" guided bomb, a prototype of which was used by the *Luftwaffe* to sink without any difficulty the Italian battleship *Roma*, as she sailed to join the Allies in August, 1943.

With the exception of the Mosquito, which worried and impressed both Hitler and Goering so much that they ordered the Me 262 to be converted into a fighter-bomber, and so gave the Allied Air Forces an invaluable respite after D-Day, Goering would not face unpleasant facts. Thus, when his experts returned from Russia in 1941 with news that, for example, output of the engine works at Kuybyshev alone was greater than the combined production of the six main German aero-engine factories, he refused to warn Hitler of the dangers of invading Russia, and told his engineers that if they made public any hint of what they had seen, they would find themselves in a concentration camp.

Those who cannot reconcile Goering the fighter ace, devoted husband and bluff diplomat with Goering whose guilt was unique in its enormity will find an answer in the words of the doctor who attended him at Langbro asylum in 1925. "As a psychiatrist," the doctor said, "I saw Goering in an unvarnished condition—and it was not a pleasant sight. I should say that his character was what psychiatrists call 'hysterical'—which means that his personality did not keep together coherently. At one moment he displayed one personality and a few minutes later quite a different one. He was sentimental about his own people and utterly callous about everybody else. When one was treating Goering one was always, to some extent, afraid of him. One could not predict what he would do next. I always knew that if I made a false step he might do terrible things. Yet, having been a German officer, he was not difficult to discipline . . . which explains his attitude to Hitler. He was basically an evil person."

Authentic Wright

"The Wright Brothers as Aeronautical Engineers," by M. P. Baker. Smithsonian Institution, Washington, U.S.A. Illustrated.

THIS little booklet has value as a work of reference out of all proportion to its small size. It provides for the first time detailed and accurate information on the Wright Brothers' "laboratory" experiments and tests with pilotless gliders, which were conspicuously absent from Fred Kelly's otherwise excellent biographies published under the titles of *The Wright Brothers* and *The Miracle at Kitty Hawk*.

Mr. Baker's thesis was presented in April, 1950, as a lecture before the National Aeronautic Meeting of the Society of Automotive Engineers. It has been reprinted from pages 209-223 of the 1950 Report of the Smithsonian Institution, and provides a further welcome reminder that the long-standing feud between Orville Wright and the Smithsonian is a thing of the past.

Photographs of the Brothers' delicate test-equipment, and reproductions of pages from their notebooks, bear testimony to the logic and thoroughness of their approach to the problem of powered flight. The reader is, in fact, left with the conviction that, even if the Wright Brothers had never left the ground in their 1903 piloted biplane, the results of their aerodynamic experiments would make them the greatest of all aviation pioneers.

BOOKS IN BRIEF

A LITTLE over a year ago—in *Flight* of February 8th, 1951, we reviewed Major Alexander P. de Seversky's much-discussed *Air Power—Key to Survival*. Now comes news that in a few weeks' time Herbert Jenkins, Ltd., are to publish an English edition, at 21s, with a foreword contributed by Air Chief Marshal Sir Philip Joubert.

* * *

ONE of the most noticeable changes on our roads since the war has been the appearance, in vast numbers, of motor-assisted pedal cycles. These little vehicles, with their phenomenal economy, have captured the imagination of all sections of the public, so it is not surprising that there should be a demand for a book about them. That need has now been met—with *Autocycles and Cyclemotors* (by the staff of *The Motor Cycle*; published at 5s, or 5s 3d by post, by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London S.E.1). Both prospective and present owners will find guidance on every aspect of the subject.

Books Recommended by "FLIGHT"

Gas Turbines and Jet Propulsion. By G. Geoffrey Smith, M.B.E. 5th Ed. Price 21s net; by post, 21s 11d.

Fellowship of the Air (Jubilee Book of the Royal Aero Club). By B. J. Hurren. Price 30s net; by post 30s 11d.

Mechanics for the Home Student. By Eric N. Simons, in association with W. D. Burnet, B.Eng., Lecturer in Mechanical Engineering at Sheffield University. Price 7s 6d net; by post, 7s 10d.

A Racing Motorist: His Adventures at the Wheel in Peace and War. By S. C. H. Davis of *The Autocar*. Price 10s 6d net; by post, 11s.

Rallies and Trials. By S. C. H. Davis of *The Autocar*. Price 15s net; by post, 15s 7d.

Roads of France—A Guide to Tourist Routes. By A. G. Douglas Cleese. Price 5s net; by post, 5s 2d.

Yachting World Annual, 1951-52 (Incorporating *Yachtsman's Annual*). Price 30s net; by post, 31s.

Obtainable at all booksellers or direct from the Publishing Dept., Dorset House, Stamford St., London, S.E.1.

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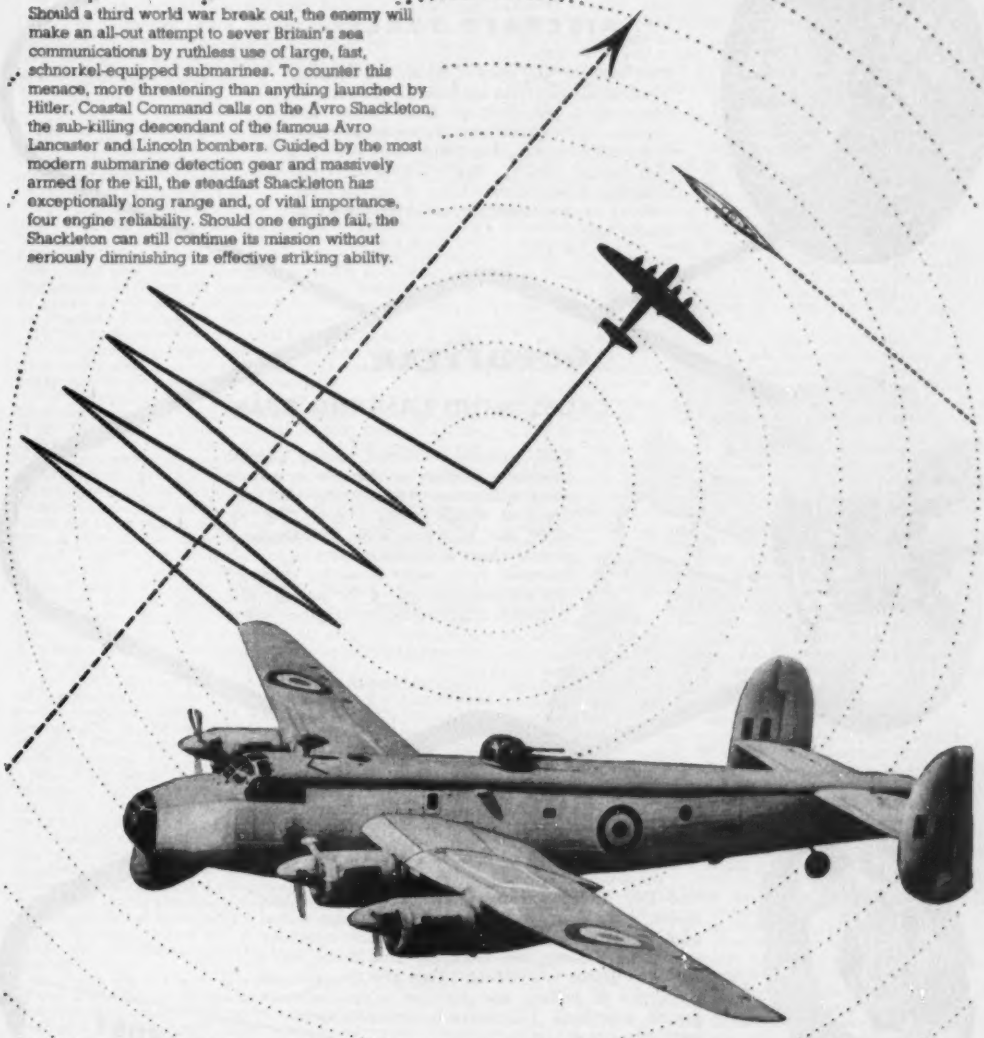

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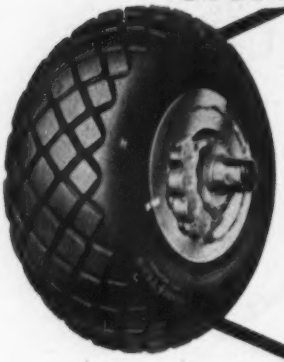

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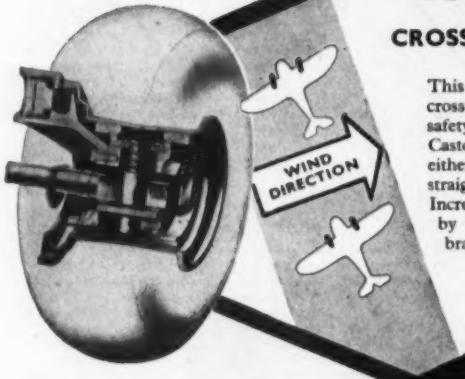

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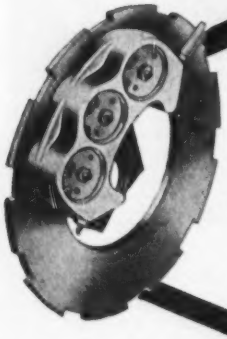
This patented Goodyear device permits cross-wind landings or take-offs in relative safety, without any tendency to ground loop. Castoring wheels permit a yaw of 25° on either side of centre while maintaining a straight course along the runway.
Increased flying safety is further enhanced by the incorporation of the popular disc brake in this revolutionary castoring wheel.



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GOODYEAR
AVIATION PRODUCTS
FOR UTMOST RELIABILITY

DEFENCE DEBATED

Super-Priority for Aircraft Production: Naval Aviation and Carrier Progress

THE Defence and Naval Estimates were the subject of long and interesting debates in the House of Commons last week. Aviation matters were frequently under review, but in the case of the Defence debates, and with the exception of the Prime Minister's speech, the references were somewhat disconnected and spread through the discussion of many other matters.

DEFENCE ESTIMATES

Opening the debate on March 5th, the Prime Minister said that his greatest anxiety in the sphere of defence was the slow rate of delivery of modern aircraft to the Royal Air Force. He had directed that "super priority" should be given to the provision of the latest and best types of fighter aircraft.

Mr. Churchill began with the comment that deliveries of modern aircraft were seriously behind the original programme which, in consequence, had had to be reviewed. As a result, the Royal Air Force—though maintaining its size—was not being re-equipped with modern machines as rapidly as it should be. Our greatest need was for modern aircraft in squadron service. At present there were no swept-wing fighters in service such as the American F-86 and the Russian Mig-15.

He agreed that it was not unnatural in this competition of types for one nation temporarily to outstrip its rivals; but it would be rather unfortunate if war were to come at the moment when the enemy had the great advantage in modernity.

The great problem was that of gauging when to change over from existing production to an improved type. The appearance of the Mig-15 in Russian squadrons in 1949 marked a considerable advance in aeronautical design, and had created a gap in our productive effort too large for safety.

Great efforts, said Mr. Churchill, were now being made to advance production of Hawker 1067 and Swift aircraft for a day-interceptor role. He emphasized, however, that these machines would not be in service in the near future or, indeed, for some time in anything like adequate numbers. Great exertions were needed to build up production to the necessary level and also to gain and keep the lead in design.

Mr. Shinwell, the former Minister of Defence, said the real bottle-neck was the difficulty experienced in persuading aircraft manufacturers to play their full part. It might be said they were doing their best, but the day might come when the Minister of Supply would have to recommend that they should be taken over by the Government to speed up production.

G/C. C.A.B. Wilcock said there had been an alarming lag in our air preparations, particularly in bombers. What was wanted was a mass-produced bomber—one without all the frills, with only pressurization in the cockpit and not throughout the aircraft. Certainly, he thought, the number of instruments in an aircraft could be reduced.

Mr. Nigel Birch, the new Parliamentary Secretary to the Minister of Defence, dealt with the run-down in aircraft production when he replied to the debate. He said this development could be attributed to the post-war policy of adjusting production to dimensions appropriate to a period of comparative peace. This had meant the evolution of the Meteor, Vampire, and Lincoln—all essentially last-war types. Manufacture in the aircraft industry had not started increasing until 1950 and the main difficulty today was simply that of restoring the correct tempo of output.

The new aircraft he mentioned as "coming along now" were, except for the Canberra and the F-86, still only prototypes. Meanwhile the Russians had the Mig-15 in very considerable quantity.

The result was that in the near future there was no prospect of enough new aircraft being put into service to deal with the Mig. The country thus faced a risk which would be very much greater if we were not blessed with Allies. The state of our air defences alone would be a reason for rearmament.

NAVAL ESTIMATES

In his statement on the Navy Estimates in the House of Commons on March 6th, Mr. J. P. L. Thomas, First Lord of the Admiralty, said that he had intended to ask for £357,250,000, or £78,750,000 more than the sum voted for 1951-52. Since the Estimates were prepared, however, agreement had been reached with the United States Government on the application of the sterling counterpart of American aid to defence expenditure, so he had also presented a Revised Estimate providing for the expected Naval share of £25,000,000 to be taken as an additional Appropriation in Aid. Thus the net cash grant required for Naval expenditure in the coming year would be £332,250,000.

Later in his speech, when he turned to the subject of Naval Aviation, Mr. Thomas said: "Every Naval officer now recognizes that this [Naval Aviation] is the main striking power of the Fleet, and Naval Aviation today employs nearly one-quarter of the total manpower of the Navy. It is, of course, important for officers and men of the Navy today to be as airminded as they are seaminded."

On the subject of the Navy's rearmament programme, Mr. Thomas said that it would be achieved, but not without delays, and he made a particular point of the shortage of shipwrights in the Royal Dockyards (600 were needed and 200 could be taken on at once at Portsmouth where the reconstruction of H.M.S. *Victorious* has been seriously delayed).

Some £38 million would be spent on new constructions during 1952-53. More than 80 per cent. of it would be ships already under construction, such as *Ark Royal*, the four *Hermes*-class light fleet carriers, the six *Daring*-class destroyers, and frigates of four types, as well as a large number of coastal and inshore minesweepers.

The fleet carrier *Eagle* had been completed and was now in commission, while her sister ship *Ark Royal*, now fitting out, was expected to be completed in 1954. Referring to the other H.M.S. *Eagle* of Elizabethan times, Mr. Thomas thought it was fitting that the first new ship to join the Royal Navy since the accession of Her Majesty the Queen was one which she herself launched at Belfast in 1946.

H.M.S. *Eagle* would be able to handle larger and faster aircraft, and to handle them more quickly and with greater ease, than any previous carrier of the Royal Navy. The *Eagle*'s two hangars were served by high-speed lifts; the flight deck covered an area of more than two acres, and the catapults for launching aircraft were more powerful than any that the R.N. had used up till now. The aircraft were put into position for loading onto the catapults by an automatic device which should greatly speed-up launching operations. Very much improved arrester-gear would accept landings by faster and heavier aircraft than any previously launched from our carriers and the new system of flight-deck lighting would make the operation of jet aircraft possible by night as well as by day. H.M.S. *Eagle* would have a peace-time complement of 88 officers and 1,337 ratings, excluding the complement of air squadrons embarked in her.

In answer to questions, Mr. Thomas added that the *Eagle* complete had cost a little over £15 million. He was unable to say when he expected the aircraft would be embarked in *Eagle*.

Turning to the *Hermes* class of light fleet carriers which were urgently required in service to match the production of modern high-performance aircraft, he said that they should be completed with as little delay as possible. The contractor's sea trials of *Centaur*, the first ship of the class, were expected to begin early next year and would be followed by those of *Albion* in the spring of 1953.

The only carrier of the *Majestic* class in hand was *Majestic* herself and she was being completed for the Royal Australian Navy, whose other carrier, H.M.A.S. *Sydney*, had done such valuable work in Korean waters.

Mr. Thomas thought that the House would be especially interested in the four types of new frigate: two types for anti-submarine work, a third for anti-aircraft and a fourth for aircraft direction. It had not been possible to produce an all-purpose vessel because modern equipment was now so great that it would not go into one vessel of a reasonable size. No one ship, therefore, could carry all, but at the same time each type could do some of the work of the other type. Two of these new types of anti-submarine frigates were laid down and well under way.

Commenting on the speed of aircraft, which was always increasing and presenting new problems for defence, Mr. Thomas said by the time a shell from the main anti-aircraft armament of a ship reached the range of its target, the aircraft would have moved on 1,000 yards, so that in the air the shell fired from astern was hard put to it to catch up with the aircraft it was pursuing. Guided weapons were obviously the answer to the problem. At the same time we were trying to improve our gunnery systems to combat the fast aircraft.

Concerning the characteristics of the front-line Naval aircraft

(*Concluded at foot of page* 304)

AIRCRAFT STEELS

Assurance of Consistent High Quality: A Note on the Work of Sheffield's Specialist Firms

STEEL is so universal a metal, perhaps the most versatile of all the alloys, that one does not immediately associate it with aircraft. And yet into aircraft go the greater percentage of the finer steels. It may not be generally known that Sheffield, a name almost synonymous with steel, produces only about one-sixteenth of the country's steel output. But that sixteenth is worth about the same amount—in terms of money—as all the remainder together: and of Sheffield's output not much less than half is devoted to aircraft. It is thus true to say that roughly a quarter of the monetary value of the total steel output of Great Britain is chargeable against aircraft.

Like almost every other constituent of modern aircraft, the high cost of aviation steels is not specifically due to the basic costs of the materials as such. Certainly, the basic costs are comparatively high in that they reflect the scarcity value of chromium, molybdenum, tungsten, vanadium, manganese, and other elements. The greater proportion of the high final cost is, however, a result of the elaborate laboratory processes required, the special furnaces and control equipment used, the exhaustive inspection procedures demanded, and the difficulties of the unit production processes.

During a recent visit to Sheffield, we were privileged to see a little of the work being done in the production of aircraft steels at the English Steel Corporation, William Jessop and Sons, Ltd., Thomas Firth and John Brown, Ltd., and Firth-Derihon, Ltd. Having had this experience, we are astonished that aircraft steels are as cheap as they are.

To take, for example, the production of a turbine blade: the cropped lengths of bar stock are heated in a furnace and, having reached the correct temperature, are withdrawn and "upset." The upsetting process reduces the original length, concurrently increasing the diameter and, in doing so, modifies the grain flow. After upsetting, the embryo blade goes through a successive series of re-heatings and re-shapings with swaging tools under the steam hammers. Following the fifth stage of shaping, the piece is drop-forged to a form which is faintly recognisable as a blade, thereafter undergoing an edge-trimming operation in a die-stamp to remove the "flash": the result is the finish-forged blade, which then has to be machined both for surface contour and base anchorage. Quite aside from the final machining, however, the production of a blade from original bar stock to finish-forged state involves no fewer than seven successive operations, between each of which every individual unit is shot-blasted and inspected for flaws.

This care and elaboration in the production processes is complemented by the activity in the research and development departments of the specialist steel companies. This activity is divisible roughly into two lines, the constant search for new "mixes," and the laboratory checking of physical properties both in short- and long-term studies. The pre-eminence of British gas turbines devolves largely on the steel scientist, for without the highly specialised steels which unremitting research has made available, the development of the gas turbine would not have been possible. Names like D. A. Oliver, C. Sykes, and H. H. Burton deserve to be better known. The evolution of high-temperature steels was in itself a great achievement, but no less an achievement is the recent development of "economy steels"—alloys in which smaller percentages of the rare elements need be used, whilst not incurring penalties in a reduction of physical properties.

The laboratory testing side of the experimental work can, perhaps, best be illustrated by brief reference to some of the equipment used. To cite but one company, William Jessop and Sons are now using equipment capable of measuring specimen temperature to an accuracy of 0.1 deg C at temperatures up to 1,000 deg C; electronic temperature-control gear which will maintain a specimen-temperature constant to within $\pm$ 0.5 deg C for testing periods up to four and a half years; extensometers that will detect changes of the order of 0.00001in in the length of a creep specimen; thermal-shock apparatus to simulate extreme working conditions of, for example, a nozzle guide vane; and creep and tensile testing equipment for turbine discs.

Seven stages in the production of a turbine blade. Between each stage the specimen is inspected for flaws.

DEFENCE DEBATED (Continued from page 303)

which have come or are coming into use, the First Lord said the present single-seat day fighter, the Sea Fury, which had proved most effective in the strike-role in Korea, was at present being replaced by the Attacker jet fighter. The Attacker was, however, only a stop-gap until the arrival of the Sea Hawk, which was now being built and to which the Navy was looking forward. He hoped it would be in service during the coming year. It would carry four 20 mm guns and a rocket battery, and it would have both greater endurance and considerably higher speed than the Attacker.

We also had on order a two-seat all-weather night and day jet-fighter, the Sea Venom. This had an armament similar to the Sea Hawk. For anti-submarine work we had the Firefly Marks 5 and 6 in service. We were developing a swept-back jet interceptor, but at the moment details of the performance could not be given. It promised to be quite outstanding. Not only were we aiming for the best aircraft for attack and defence, but we were not overlooking the potentialities of the helicopter for anti-submarine and rescue work.

Mr. Thomas then spoke about the development of the new high-performance steam catapult. He gave no answer to questions regarding progress with the Fairey G.R.-17, how it was coming along, or whether the programme had dropped back.

The build-up of Naval Aviation meant that we had got to have airfields and shore accommodation adequate for these new aircraft. There had to be lengthening and modernizing of runways to meet the needs of jet aircraft. The U.S. Navy had been very generous in offering us a chance to undertake pilot training out there to help with our air expansion while these alterations were going on, so that our programme of training would not be held up.

CIVIL AVIATION

THE "DOLLAR SHOWCASE" COMETS

ON his arrival at London Airport from New York on March 5th, Sir Miles Thomas, chairman of B.O.A.C., gave his views on a number of aspects of British air transport. Sir Miles said: "I made preliminary arrangements while in America for our own Comet services to start, subject to delivery of aircraft, at the end of this year from New York to Nassau, New York to Bermuda and New York to Jamaica. A good deal of work on local airports and fuelling arrangements is necessary. Plenty of time has been given to the local authorities to get ahead with them."

The announcement of increased production facilities for the Comet, Sir Miles said, was good news indeed. On the previous day he had lunched with Mr. Juan Trippe, President of Pan American Airways, and found him to be very interested in the potentialities of the Avon Comet which B.O.A.C. proposes to use on the transatlantic and other routes.

Sir Miles indicated that the overall B.O.A.C. results for the current financial year, ending March 31st, will be at least £4,000,000 better than last year's and that the first month's bookings for tourist-fare transatlantic services indicate how right the introduction of these services is—bookings for May show an increase of 117 per cent compared with the same month last year and an increase of 82 per cent in dollar earnings.

SCANDIAS FOR ARCTIC ROUTE

THE "Route of the Midnight Sun," from Oslo into Norway's arctic, is, according to *Saab Sonics*, to break with its long tradition: in future it will be flown with landplanes. Before the 1939-45 war Det Norske Luftfartselskap pioneered this difficult coastal route with Junkers W.34 and Ju52/3m floatplanes; following the war the Ju52s went back into service, but for some years up to the close of the route for the winter in 1951 a fleet of Short Sandringham flying-boats was used for the Stavanger-Bergen-Oslo-Trondheim-Bodö-Harstad-Tromsö sectors and the Ju52s continued this route from Tromsö to Kirkenes, near the Norwegian-Soviet border. The operation of flying-boat services has always been uneconomic as the route has had to be closed in winter months, with consequent low utilization.

ELIZABETHAN CAPTAINS: This photograph, taken during the recent proving flight to Switzerland, France and Italy of the B.E.A. Elizabethan aircraft, R.M.A. "William Shakespeare," shows (left to right) Capt. W. Baillie, chief flight captain, B.E.A.; Capt. J. W. G. James, director of flight operations, and Capt. C. F. Riley, flight captain of the Elizabethan flight. A picture of the aircraft at Nice appears on page 288.

SUPER-CONSTELLATION PRODUCTION: Deliveries of Eastern Air Lines' fleet of 14 L-1049 Constellations are almost complete; 11 had been delivered by the end of February. The second order for this type was placed by T.W.A. and four for this company are here seen under construction at Burbank, California. T.W.A. should receive its first L-1049 in mid-summer and in the autumn Eastern Air Lines are due to get the first of their 16 turbo-Cyclone-powered L-1049C Constellations.

Beginning on June 1st, the Norwegian region of Scandinavian Airlines System is to operate six return flights a week between Oslo and Bodö *via* Trondheim, using Saab Scandia 26/32-passenger landplanes. The existing airfield at Vernes, near Trondheim, will presumably be used, while at Bodö a new airport is nearing completion. S.A.S. is hoping to achieve year-round service with the Scandias on this route and this year operations are to continue to December 1st. The introduction of the Scandia on this route is expected to save the Norwegian taxpayers some N.Kr.1,000,000 (£50,000).

C.A.B. SLUMP WARNING

AT a meeting of the Aero Club of Washington, the vice-chairman of the U.S. Civil Aeronautics Board, Mr. Oswald Ryan, gave the warning that the airlines must prepare for a slump if and when military operations in various parts of the world eventually come to an end.

Mr. Ryan said that present increases in air traffic were to a great extent directly related to military activity. He added "A financial setback today, comparable with that which the airlines suffered in 1947 and 1948, would call for subsidy aid of an amount far greater than that required a few years ago. It is at least doubtful whether Congress would be willing to contribute so large a sum."

AIRPORT MOATS NEEDED?

THE three recent transport-aircraft accidents at Elizabeth, N.J., may have far-reaching effects on U.S. airline operation. Following the closing of Newark Airport (near Elizabeth), the State of New York has approved a bill requiring aircraft, "whenever possible," to fly over rivers, streams or waterways instead of directly over New York City or Buffalo. The Presidential Commission to inquire into airport and airport-control conditions at Newark is also to visit other airports near New York, Chicago, Los Angeles and San Francisco. Lt.-Gen. James H. Doolittle, who heads the commission, said: "The work of this commission will be to make a nation-wide study of civil and military airport facilities, their location as to convenience and utility, and the problems they may present as to nuisance and possible danger." He also said that the commission would hold no open hearings; interested parties would give their opinions in camera.

I.A.T.A. FIXTURES

A PROVISIONAL list of dates and venues of 1952 I.A.T.A. conferences and committee meetings of various kinds has been issued, and is given overleaf.

Precise dates and places have yet to be decided for three events: summer meetings of the Accountancy and Statistical Sub-Committee and Facilitation Sub-Committee and an autumn

CIVIL AVIATION...

Traffic Conference of 3 Agency Sub-Committee, possibly to be held in Singapore. Dates and places are as follow :—

Mar. 27th, Traffic Conference 1 Agency Sub-Committee, 14th Meeting (Mexico); Mar. 31st, Composite Agency Sub-Committee (Mexico City); Apr. 1st, Insurance Sub-Committee (New York); Apr. 28th, Warsaw Convention Special Committee (Bermuda); Apr. 30th, Legal Committee (Bermuda).

May 5th, Fifth Annual Technical Conference (Copenhagen); May 11th, Traffic Committee, 15th Meeting (Buenos Aires); May 12th, Clearing House and Revenue Accounting Sub-Committee (Rome); May 13th, Composite and Joint Traffic Conferences (Buenos Aires); May 19th, Technical Committee, 14th Meeting (Copenhagen); May 19th, Medical Committee, 2nd Meeting (Copenhagen); May 21st, Financial Committee, 10th Meeting (Rome).

Sept. 12th, Executive Committee, 24th Meeting (Geneva); Sept. 15th, Eighth Annual General Meeting (Geneva); Sept. 16th, Traffic Conference 1 Agency Sub-Committee, 15th Meeting (venue to be announced); Sept. 19th, Executive Committee, 25th Meeting (Geneva); Oct. 7th, Traffic Conference 2 Agency Sub-Committee, 16th Meeting (Paris).

P.A.A.'s DC-6Bs

WITH the inauguration on May 1st of North Atlantic tourist services, Pan American World Airways will introduce 82-passenger DC-6Bs on its New York to London "Rainbow Service," to be operated four times weekly. The frequency of tourist services into London will reach ten a week during the peak period and already 60 per cent of the company's tourist accommodation for mid-summer has been booked. Last year P.A.A. carried 92,601 Atlantic passengers and this year will offer 200,000 seats on the transatlantic services.

DC-6Bs will also operate to France, Italy, Germany, Belgium and Holland. On August 1st they will replace Constellations on the London - Middle East - India services and later in the year these aircraft will operate the round-the-world services. Eventually the DC-6Bs will replace all the Atlantic Division Constellations.

The weekly New York-London DC-6A cargo service will continue to be operated for P.A.A. by Slick Airways.

NEWS FROM MEXICO

A BILATERAL agreement has recently been signed by France and Mexico for the operation of passenger, mail and freight air services between these two countries. The French services will be operated by Air France, with Constellations and it is reported that scheduled flights will begin next month.

Two Mexican companies are interested in flying this route and a decision as to which company will be approved by the Mexican Department of Communications is expected shortly.

The two Mexican companies are Aerovias Guest S.A., which has already had transatlantic operating experience and which is currently operating a DC-4 service between Mexico and Miami; and Compañia Mexicana de Aviación S.A., which flies DC-6s between Mexico City and Havana, and DC-3s and DC-6s from Mexico City to Los Angeles, in addition to operating a network of local services.

It is reported from Mexico, that C.M.A. has now purchased Aerotransportes S.A., a small company which has been running cargo and limited passenger services between Mexico City and the northern part of the country. C.M.A. now plans to extend its internal services to Brownsville and Reynosa, on the U.S.-Mexican border.

IRISH PEER: A model of the Vickers-Armstrongs Viscount 707 finished in the green markings of Aer Lingus, who have ordered four of these 40-passenger machines for service on their Dublin-London, Paris and Amsterdam routes.

ASK, DON'T LOOK: The illustration ("Look, Don't Ask") of the Aer Lingus flight-arrival indicator at Dublin Airport, published in "Flight" of February 29th, has prompted B.E.A. to produce this photograph, taken in No. 3 passenger arrival building at Northolt Airport. It shows an inquirer using one of the green telephones which are linked directly with the flight-information branch.

PACIFIC AIRLIFT

DURING 1951, Seaboard and Western Airlines, Inc., carried a total of 2,314.64 tons of military freight and mail on the Pacific airlift to Tokyo. This amounted to 10 per cent of the total 23,000 tons flown to the Far East during this period by military and commercial aircraft in the operation, which is under the control of Military Air Transport Service of the U.S.A.F.

The company's fleet of DC-4 "Airtraders" also lifted 2,248 of the 68,000 high-priority military personnel flown on the operation. Of the 5,800 airlift flights made during the year, Seaboard and Western made 367.

In all, the company carried 8.4 per cent of the total tonnage of freight, mail and passengers, though they flew only 6.3 per cent of the trips.

BREVITIES

FIRST of the *ad hoc* London-Paris services of B.E.A. to be operated by an Elizabethan aircraft since the brief introduction of the type in 1951, was flown on March 3rd, by R.M.A. *William Shakespeare*, commanded by Capt. C. F. Riley. This same machine was due to make a proving flight to Zürich and Vienna on March 11th-12th.

* * *

In order to meet the demand for fast services between Sydney and Tasmania, both T.A.A. and A.N.A. have begun direct Sydney-Hobart flights, thereby saving an hour compared with the old route *via* Melbourne. These new services are in competition with the Solent services of Trans Oceanic Airways.

* * *

A scheduled passenger-service between Dublin and Rhoose, in South Wales, is due to be opened by Aer Lingus on June 10th and the Minister of Transport and Civil Aviation has said that the necessary arrangements are now being made at Rhoose. He said that Rhoose will probably be developed as the future airport for Cardiff and South Wales.

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Australian National Airways had a record year for air freight in 1951, when 78,728,378 lb was carried; this is 13,000,000 lb more than in 1950. The company now operates 112 scheduled cargo-flights a week, employing three Bristol 170s and three DC-3s exclusively for this work.

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Silver City Airways is engaged in carrying a large number of British-built Ford cars from Lympne to Le Touquet; it is expected that over 40 cars will have been carried by the end of the first week. Recently the company has also been busy carrying animals; a stag and two does in fawn were flown into Berlin to start replac-

ing those destroyed in the Grunewald during the war, a number of racehorses were flown from Paris to Blackbushe and Bristol, and 2,000 cattle (see pages 284-285 of this issue) travelled from Lympne to Le Touquet.

* * *

On April 20th, B.E.A. is to start a daily Manchester-London service with Viking aircraft. There will be an early morning departure from Manchester and an evening departure from Northolt, allowing about six hours to be spent in London. Flying time will be 1 hr 10 min.

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The U.S. Civil Aeronautics Board has rejected new proposals for domestic air-coach services to be operated by a number of U.S. airlines, and the six companies at present operating such services must reach new agreements with the C.A.B. before the end of March or else lose their certificates. The Board suggests that air-coach fares could be reduced from the present rate of about 4½ cents per mile to 4 cents or lower. In order to bring about the lower fares, the C.A.B. recommends that more passengers should be carried in Constellations and DC-6s—possibly as many as 80 in the former.

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Swissair is reported to be considering the operation of a direct service linking Zürich and Montreal. DC-6Bs would be used.

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About 1,500 passengers a day are expected on Scandinavian Airlines System's Stockholm-Helsinki services during the forthcoming Olympic Games. British European Airways will be operating a daily London-Copenhagen-Helsinki Viking service from July 11th to August 11th.

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A pioneer British airline engineer has just retired after 32 years' service with B.O.A.C. and its predecessors, Imperial Airways and the Instone Air Line. He is Mr. W. E. Clark, who was B.O.A.C.'s engineering manager at London Airport until the end of last month. He joined the Aircraft Manufacturing Company at the end of the 1914-18 war, and later served with the pioneer British Airline, Aircraft Transport and Travel, Ltd.

FROM THE CLUBS

DURING January and February, the Wiltshire Flying Club logged 147 hr 10 min, a figure slightly down on that for the corresponding period last year, but nevertheless a very creditable one considering the adverse week-end weather experienced. During the last few months, advantage has been taken of the depressing climatic conditions to complete the annual overhaul of all the club aircraft and those of the Royal Artillery Flying Club. The W.F.C. can now place at the disposal of its members five Autocrats, four Tigers and a brand new Autocar, the last-named recently purchased by the Royal Artillery Flying Club. This lavishly-equipped four-seater is available to members at £3 10s an hour, and the W.F.C. remarks that, four up, this machine provides travel at something like railway rates.

Thruxton Aerodrome will be closed to visitors on April 12th, 13th and 14th, as the first national motor cycle race meeting is to take place there on Easter Monday. Members flying from the airfield on local flights will be allowed to operate as usual, although they are asked to obtain prior permission from the C.F.I., as there are likely to be various obstacles on the airfield.

DESPITE unfavourable early weather reports, the Southern Aero Club at Shoreham successfully staged its first flying event of the season in the form of a lunch patrol on Sunday, March 2nd. The weather, as so often is the case, turned out to be much better than forecast. The event took the usual form: it began at noon, when the defending aircraft of the S.A.C., under the leadership of the C.F.I., Mr. C. L. Pashley, took off to patrol their respective sectors. A quarter of an hour later the attack was under way, and lasted until 12.45 p.m. Soon after, some thirty aircraft were parked outside the new club-house and over a hundred enthusiasts were preparing to do justice to the lunch so well prepared by the S.A.C.

Of the thirty invaders, only three managed to get in without having their registration letters taken; the lucky (or skilful) pilots were Mr. Neville Browning from Herts and Essex Aero Club in his dark green Messenger; Mr. Hall from Elstree Flying Club, flying an Auster Autocrat; and Mr. McLean from the Airways Aero Club, in a Magister. These three qualified for a free luncheon.

Apart from privately owned types, there were club-owned machines from Airways Aero Club, Denham; Elstree Flying School; London Aeroplane Club; Herts and Essex Aero Club; Wiltshire Flying Club; Redhill Flying Club; the Experimental Flying Group of the U.L.A.A. (represented by Moth Minor G-AFPR), and various others. Much amusement was caused when Cdr. J. S. Sproule arrived in his Piper Cub, from which he proceeded to unpack a small cycle which he "drove" furiously across the airfield.

Incidentally, the S.A.C. annual subscription now stands at £2 2s, covering both flying and social membership; monthly membership is also available, at 10s 6d.

ENCOURAGING news comes from the chairman of the Northamptonshire Aero Club, Councillor C. M. Newton, who, in his speech at the club's recent annual general meeting, indicated that private flying seemed more popular than ever in the club's area. He stated that instructional flying had increased by more than 100 hours over the previous year's total and that 17 members had been granted P.P.L.s. In addition, eight A.T.C. cadets had been trained under the flying scholarship scheme; three are at present under instruction.

On June 14th an air display will be held at Sywell Aerodrome, from which the N.A.C. operates, on behalf of the Air Rangers (Girl Guides Association); Royal Air Force support is being given.

LIGHT-AIRCRAFT DESIGN COMPETITION

THE first of what may be a number of civil aircraft design competitions is being promoted by the Royal Aero Club, with prizes provided by the Kemsley Flying Trust.

The competition is for a light aircraft built to a specification drawn up by the promoters, and it is open to British subjects only. Entries should be submitted to the Secretary-General, The Royal Aero Club, 119 Piccadilly, London, W.1, before December 31st, 1952, and intending entrants are asked to inform the promoters immediately of their intention to participate. Prizes of £100, £50 and £25 will be awarded. The design-rights will rest with the entrant, but the R.Ae.C. reserves the right of publishing details of any design in the *Royal Aero Club Gazette*.

Chief details of the specification are as follow:—

The aircraft shall be designed around a four-cylinder in-line inverted, air-cooled engine of 75 maximum b.h.p. It shall be a two-seater, with dual control, capable of carrying up to 50 lb of baggage. The specification lays stress upon good handling characteristics and the ability to operate from small grass fields; it further states that the aircraft shall be stressed to qualify for a normal category C. of A.

The design should be submitted in such a form that it could be handed over to a drawing office for detailing with the minimum subsequent supervision on the part of the designer. As a rough guide, the following is suggested—that a three-view G.A. drawing showing principal dimensions should be submitted, together with similar drawings of wing and fuselage, showing location and dimensions of major structural components. Further drawings, or sketches, should be submitted giving the layout of controls and equipment and the details of any unusual features, including such description as may be necessary. The promoters give no guarantee of the safe return of documents, and ask entrants not to submit originals; they would appreciate four copies of all drawings and papers. A type record containing aerodynamic, structural and performance estimates should be included, the entrant quoting all sources of information used; finally, costing estimates are required, based upon an estimated first quantity of fifty aircraft.

This competition, *Flight* feels, is certain to bring an enthusiastic response, even though no guarantee can be given that the winning design will ever be built. One point which might be raised is that the character of any design submitted will be greatly influenced by the expected total production. The promoters would not bar, or discriminate against, any competitor submitting a novel design, or one requiring high initial tooling costs, provided he explained why any particular feature, or method of construction, was adopted.

In conclusion, it is to be assumed that the specification quoted for the proposed power plant does, in fact, refer to an actual engine now under development. The specification is as follows: four cylinders in line, four-stroke, inverted, air-cooled, direct drive. Bore, 3.937in; stroke, 5in; swept volume, 3.98 litres; weight, with fuel pumps, 225 lb plus or minus 2½ per cent. Maximum continuous power, 75 b.h.p. at 2,300 r.p.m.; fuel consumption at recommended cruising power (60 b.h.p.) 5 gal hr. Estimated capital cost of engine, £285.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Navy and Coastal Command

THE R.N.-R.A.F. feud goes on, as it has done for thirty years. The R.N. wants the major part of Coastal Command. What next? The moon and stars?

I was many years in both Services, but never in the R.N.A.S., and served in the old *Argus* in the early twenties, before R.N. officers were employed as observers and eventually as pilots. Coastal Command was then called the Coastal Area. On board the carriers, and on Coastal Area stations, senior officers were mostly ex-R.N.A.S. with naval experience also, and were worthy of their responsible posts.

I have memories of pioneers of Naval Aviation of whom the R.N. was justly and rightly proud: Longmore, Gerard, Maclean, Samson, Oliver, Bigsworth, Hewlett, Durston, Bowhill and many others; some have passed on, others are on the retired list. All the observers were ex-R.N., having begun their careers as boys and signal and wireless ratings, eventually becoming warrant officers in the R.N.A.S. Some are now group captains and wing commanders on the retired list. I well remember actually serving with many of them as a sailor in the Bolshevik Campaign of 1919. When they were in the R.N. and R.N.A.S. no naval man dared to find fault with them, but the Navy did find fault with them when the R.A.F. became properly established on board the carriers.

I remember the very start of the feud. "The R.A.F. are useless throw-outs from the Navy and Army" and other such remarks were made; no matter what the R.A.F. did, credit was never given. Then came the time when the Fleet Air Arm was formed in 1924, and in 1925 70 per cent of the pilots were R.N. officers trained by the R.A.F. In 1938 (or was it 1939?) the R.N. pushed the R.A.F. off the carriers, retaining a few skilled mechanics as a matter of convenience. Now, it would seem, they are trying to turf us out of Coastal Command.

If the Navy is to have Coastal Command, what is going to happen to Bomber and Fighter Commands, since all these commands co-operate in anti-submarine warfare?

I do not consider the matter a difficult one; there has always been co-operation between the armed forces. Why two flying Services? Since the R.N. does not want the control of the whole arm of the R.A.F., why not hand Naval Aviation back to the R.A.F.? There will still be co-operation.

London, S.W.15. E. G. R.

Sobs from a Saab

I BEG you to right a wrong, on behalf of continuing good Anglo-Swedish relations.

The other day I found a young friend of mine greatly in distress. Tear-stained and overcome with emotion, I had to use my eyes to discover the cause for such a state. As the snow lay round about (deep, crisp and even so, good value for the time of year—advt.) I spotted an open copy (February 22nd) of *Flight* . . .

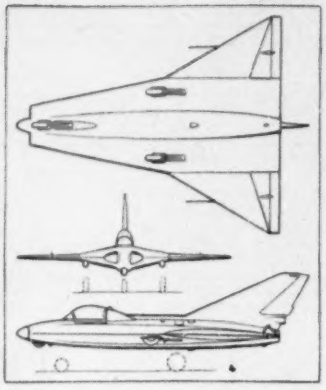
"Is this what has upset you, young Draken?" said I, pointing to an erudite offering by one Mr. Walker. A reddened and swollen nose twitched affectingly and the reply, charged with emotion came, "Yes, yes, yes! Dragon indeed!"

Attempting sympathy, I tried to explain, "There, there, little one, you mustn't mind the English. They mean well but because of their insular sort of humour (*vide Punch* and Yuletide issues of *Flight*), they do not believe that we isolationist Swedes have any sense of fun."

"B-b-but," exploded young Draken, "I am NOT a Dragon! I am too small and too inoffensive to be called a Dragon. I like my Swedish friends to call me by the pet name Kite. Why, just look at my shape and the funny tail they have put on my stern! Doesn't that long parachute remind the English of the tail of a kite? Please, oh please, make a drawing of me and send it to *Flight*!"

Patting his young (radar) nose, I bid him adieu and promised to write a polite note pointing out that Draken can mean more than one thing. Perhaps the attached likeness speaks louder than my awkward English.

Stockholm. BJÖRN KARLSTRÖM.



This new G.A. drawing of the Saab-210, or Draken (Armstrong Siddeley Adder) is based on latest information. Approximate dimensions are: span, 16ft. 3ins.; length overall, 23ft.

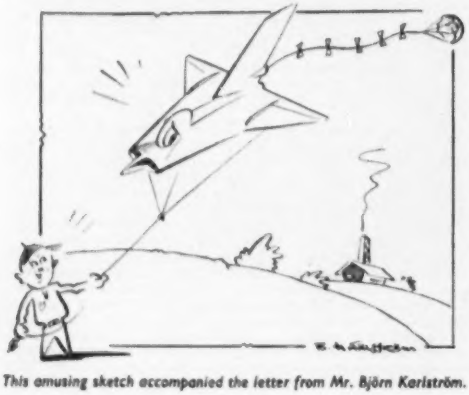
Historic Hat

MAY I record not only what I personally feel, but that which I have heard on all sides—unqualified admiration for John Yoxall's magnificent photography in feature articles on R.A.F. squadrons?

I believe I am right in stating this: that the flying helmet he now wears is the same helmet he has used for 20, or even 30, years? Portrait, please.

Royal Aero Club, London W.1. B. J. HURREN.

[John Yoxall regrets to report the loss of the above-mentioned headgear, which he bought for 6s when he joined the staff of *Flight* 39 years ago. The ear-rolls with which it was adorned were removed in 1932: they were thought to be old fashioned!—ED.]



This amusing sketch accompanied the letter from Mr. Björn Karlström.

FORTHCOMING EVENTS

Mar. 19. Aircraft Recognition Society: "Future Developments in Civil Aviation," by Peter G. Masefield, M.A., F.R.Ae.S.
Mar. 20. R.Ae.S: "Terminal Air-traffic Control," by G/C. E. A. Whiteley, D.F.C., B.A., A.F.R.Ae.S.
Mar. 21. Helicopter Association: "Recent Helicopter Research Investigations," by W. Stewart, B.Sc.
Mar. 25. R.Ae.S. Graduates' and Students' Section: Annual General Meeting and Talk on "Aerodynamic Oscillations of Suspension Bridges," by C. Scrutton, B.Sc., A.F.R.Ae.S.
Mar. 26. R.Ae.C.: Annual General Meeting.
Mar. 27. R.Ae.S. Section Lecture: "Civil Jet Aircraft Performance," by D. R. Newman, A.F.R.Ae.S.
Apr. 4. College of Aeronautics: Senior Common Room Society's Annual Dinner.
Apr. 6. London Aeroplane Club: Dawn Patrol and A.G.M.
Apr. 15. R.Ae.C.: Film Show.
Apr. 22. R.Ae.S. Graduates' and Students' Section: "Servomechanisms," by F. H. Bortase, B.Sc.(Eng.), Grad.R.Ae.S.
Apr. 24. R.Ae.S.: "Fuel Systems for Turbine-driven Aircraft," by J. E. Walker, A.F.R.Ae.S. (at Luton).
May 3. Vintage Aeroplane Club: Rally, White Waltham.
May 3-10. F.A.I.: Committee Meetings, Madrid.
May 5. I.A.T.A.: Fifth Annual Technical Conference, Copenhagen.
May 5-16. British Industries Fair.
May 10. Exeter Aero Club: Display.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

A Dakota of the R.C.A.F. after landing on the sea ice with supplies for the meteorological station at Clyde Inlet, off the extreme north-east coast of Canada. The flight combined the duty of taking in supplies with that of carrying out navigational and cold-weather training.

S. of S. at S.H.A.P.E.

AT the invitation of General Eisenhower, the Secretary of State for Air, Lord De L'Isle and Dudley, visited S.H.A.P.E. headquarters, on Monday and Tuesday of this week.

He flew in a Valetta from West Malling, Kent, to Villacoublay, Paris, where he was received by Air Chief Marshal Sir Hugh Saunders, Dep. Supreme Commander (Air).

Appointments

AFTER having been Senior Air Staff Officer of 2nd T.A.F. and B.A.F.O. for the past two years, A. V-M. Sir Harry Broadhurst is to be the new commandant of the School of Land/Air Warfare at Old Sarum, Wiltshire. His place with 2nd T.A.F. will be taken by A. Cdre. J. H. Edwardes-Jones, who, until recently, was Director of Plans at the Air Ministry. A. Cdre. Edwardes-Jones will assume the acting rank of air vice-marshal.

R.O.C. Examinations

IN an examination, which will take place in 80 towns all over the country on Sunday next, half the questions will be posed on cinema screens. Sixty shots, chosen from a list of 120 British and foreign aircraft, will each be screened for three seconds. An average of 90 per cent correct in both this and the written test is necessary to qualify for the Spitfire Badge.

Some 12,650 observers will take part in these tests and a further 2,140 in plotting-table tests, where the same high standard of 90 per cent is required.

The R.A.F. Fighter Command Cup, originally presented in 1945 as a token of Fighter Command's appreciation of the work done by the R.O.C. in the war, will be awarded to the Group whose observers come out of the tests best.

American Missionary

MAJOR JAMES A. JABARA, U.S.A.F. —an interview with whom is the subject of the article on page 287—has been visiting R.A.F., R.C.A.F. and U.S.A.F. bases in this country. Last Monday, March 10th, he was due to lecture at H.Q. Fighter Command in the morning before going on to Old Sarum in the afternoon for a second platform appearance. On Tuesday he was due at the Central Fighter Establishment, West Raynham, and next day had a morning stop at H.Q. 81st Wing, U.S.A.F., at Bentwaters, before going on to the 1st R.C.A.F. Fighter Wing, North Luffenham, in the afternoon. He was then to return to Fontainebleau (H.Q. Allied Air Forces, Central Europe) under whose auspices the British tour was made. After a short stay in France Major Jabara was to resume his post as an instructor at H.Q. Air Training Command, Scott Air Force Base, Illinois.

Cooper Trophy Presented

AT Biggin Hill, on Sunday last, Air Marshal Sir Basil Embry, A.O.C-in-C. Fighter Command, presented the Cooper Trophy to No. 615 (County of Surrey) Squadron, R.Aux.A.F., of which unit Mr. Winston Churchill is the Honorary Air Commodore. Unfortunately, the Prime Minister was unable to be present, but sent the following message, which was read by G/C. E. J. Davis :—

"On this occasion of the presentation of the Cooper Trophy, I send my congratulations and good wishes to all ranks of 615 County of Surrey Squadron for having attained this honour, which by their efficiency and prowess they so well deserve.

"It is not always easy to give up one's free time after the cares and troubles of a week's toil are done, and it is mainly through their keen enthusiasm and willingness to serve that they have achieved the right to hold this Trophy.

"615 Squadron may indeed be proud today that they are carrying on the great war-time traditions of the Service."

Sir Basil, in a brief speech to the assembled company, remarked on how appropriate it was for a Fighter Command trophy to be awarded for air gunnery—bearing in mind the skill, expense and effort required to get the weapon on the target. He stressed, also, that such an award was won not only by the pilots who pressed the triggers, but by the cumulative effort of every member serving in the unit.

S/L. F. B. Sowrey, who now commands No. 615, received the trophy on behalf of the squadron.

The idea of presenting a trophy came to W/C. Cooper while he was still a member of No. 615 Squadron in 1939, and the intention then was to keep it for competition within the unit. The war came, but W/C. Cooper got the sculptor, Gilbert Baynes, to proceed with the design. The trophy was finished in time to offer it to the Air Council in 1946, who decided to award it for an annual high-speed contest between the R.Aux.A.F. fighter squadrons. Last year it was decided to change the character of the contest and award the trophy to the unit achieving the best results in live air-to-air firing. No. 601 (County of London) Squadron was placed second.

FOR SHOOTING: Air Marshal Sir Basil Embry presents the Cooper Trophy to S/L. F. B. Sowrey, C.O. of No. 615 (County of Surrey) Squadron, R.Aux.A.F.

Exercise High Time

AT the close of the three-day air exercises, "High Time," in the Canal Zone, A. V-M. D. F. W. Atcherley, A.O.C. No. 205 Group, who directed the operations, stated that he was very pleased with the manner in which they had been carried out—particularly with the speedy rearming and refuelling.

Phase five, which closed the exercise, was another period of concentrated activity. All types of aircraft in the Zone took part with the exception of Mosquitoes. The Lincolns were joined over targets by bombers from Cyprus while Meteor escorts put up protective screens. Approaching their objectives they were intercepted and engaged by a full Vampire wing.

SERVICE AVIATION . . .

New Wigram Commandant

IT is announced that G/C. B. S. Nicoll is to take over command of R.N.Z.A.F. Station, Wigram, from G/C. A. B. Greenaway. G/C Nicoll is at present Director of Postings and Personnel Services.

Under the compulsory training programme in New Zealand, the electrical and signals courses are being held at Wigram.

N.Z. Air Force Day

FROM New Zealand comes a report of Air Force Day, celebrated on February 23rd at R.N.Z.A.F. station Whenuapai. Brilliant sunshine, coupled with excellent flying, combined to make the occasion a memorable one.

The display began with a fly-past led by a Catalina, followed by two Mk 31 Bristol 170s, six Dakotas, six Mosquitoes, a lone Mustang, three Harvards and two Vampire 5s.

The most popular item followed—the destruction of a fort by No. 75 Squadron's Mosquito 6s (almost at runway level) and No. 14 Squadron's Vampire 5s. The anti-aircraft guns of the Army put up an heroic defence but were soon "annihilated," and Dakotas of No. 41 Squadron then came in, dropping men and supplies to clean out the area.

Graceful silent aerobatics by an Olympia sailplane were followed by the crackling roar of a Merlin as an F-51D Mustang roared over to give the best demonstration of aerobatics of the day—rolls, loops, rolls off the top, inverted runs and then a perfect hesitation roll that really had the crowd on its toes.

A Bristol Freighter gave a demonstration of its capabilities with one airscrew feathered, and the Mosquitoes of No. 75 Squadron gave the crowd a taste of formation aerobatics and stream landings and take-offs. The leader rounded-off the item with a demonstration of single-engine performance on this perennial (and still excellent) aircraft.

The last item consisted of solo and formation "jetabatics" (as the commentator put it) in Vampire 5s, the most impressive being a very low inverted run.

In the static display were, among other things, a German V-1, while aircraft included a Devon C Mk 1, Bristol 170 Mk 31, F-51D Mustang, C-47 Dakota, Vampire 5, Harvard, Mosquito 6 and Consul. Photographic equipment and radio were in No. 2 Hangar and on the square outside the ops. room was the A.T.C. with many excellent control-line models, including a beautifully finished Percival P.56 Provost.

FOR UNITED NATIONS SERVICE: At the first Australian investiture of the new reign, Sir William McKell, the Governor General, decorated a number of R.A.A.F. officers who had served in Korea. Left to right are S/L. C. W. Butcher (M.B.E.), S/L. S. J. Barrow (M.B.E.), F/L. J. Adams (D.F.C. and A.F.C.), S/L. C. Noble (D.F.C.), F/L. D. McLeod (D.F.C.) and P/O. R. Trebilco (D.F.C.).

R.A.A.F. to have G.C.A.

THE Australian Minister for Air, Mr. W. McMahon, has announced that the principal R.A.A.F. airfields are to be equipped with G.C.A. The necessary material is on its way from America and will be installed as quickly as possible.

Australian Fighters for M.E.

SPEAKING in the House of Representatives, the Australian Prime Minister last week announced the decision to send No. 78 R.A.A.F. Fighter Wing to serve in the Middle East. This Wing would comprise Nos. 75 and 76 Squadrons and their supporting units.

These squadrons are at present equipped with Australian-built D.H. Vampires, but it is not intended to take them to the Middle East; new aircraft will be drawn from R.A.F. stores on arrival. In command will be W/C. Brian Eaton, who during the war served in the same area and also in Southern Europe. It is expected that the Wing will leave Sydney by sea in June and may be stationed on the island of Cyprus.

University Easter Camps

NEARLY 400 members of University Air Squadrons, approximately 100 more than last year, have volunteered to attend R.A.F. stations for training during the Easter holidays. Dates and locations of camps are :—

London ...	Booker, Bucks	March 24-April 9
Oxford ...	Kidlington	March 23-April 20
Southampton	Hamble	March 24-April 26
Bristol ...	Filton	March 22-April 10
Leeds ...	Sherburn-in-Elmet	March 23-April 21
Nottingham	Newton	March 21-April 10
Durham ...	Ouston	April 8-April 21
Hull ...	Brough	March 23-April 5
Liverpool ...	Woodvale	March 23-April 6
Manchester	Barton	March 26-April 8
Birmingham	Honiley	March 23-April 6
Glasgow ...	Perth	March 15-March 30
Aberdeen ...	Dyce	March 17-March 30
Edinburgh...	Perth	March 17-March 30
St. Andrews	Leuchars	March 17-March 28

For the newly established Squadrons at the Universities of Hull and Liverpool this will be the first Easter Camp. Cambridge University and Queen's University, Belfast, will not hold Easter camps this year.

R.A.F. Club A.G.M.

THE annual general meeting of the Royal Air Force Club will be held at 1730 hr on Monday, March 31st.

Reunions

OFFICERS who served at the headquarters of Flying Training Command during the years 1939 to 1945 will hold their first reunion, in London, on Friday, April 25th. Details may be obtained from S/L. A. C. Howell, 19, Bramley Road, Cheam, Surrey (Ewell 2413).

A REUNION for both R.A.F. and W.R.A.F. personnel who served at R.A.F. Station Wickenby (1942–1945) will be held at Lincoln on May 3rd; F/L. W. T. Abbott, College of Aeronautics, Cranfield, Bletchley, Bucks, is the organiser.

EXERCISE SUN DOG: R.C.A.F. Reserve squadrons co-operated in the recent ten-day winter army-air training exercise held in eastern Canada. Nos. 406 (City of Saskatoon) and No. 418 (City of Edmonton) Squadrons formed the striking force, but photo-reconnaissance and transport elements also took part. Reserve-squadron Mitchells are seen being bombed-up at Goose Bay, Labrador.

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VENDAIR, Croydon Airport, offer Lycoming P. & W. 1830/92, Cheetah X, Queen II. Also available propellers for Auster, Messenger, Gemini, Tiger, Magister. —Vendair, Croydon Airport, Croydon 5777. [0057

AERO SALES, Inc., procurement specialists for all American aircraft, engines, accessories. Quotations furnished on all requests.—Address: P.O. Box 37, Miami International Airport Branch, Miami 48, Florida, U.S.A. London Agents: C. J. Fox and Sons, Ltd., 117, Victoria Street, London, S.W.1. Tel.: Victoria 0204/5. [0045

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On Monday, March 24th, at 12.30 p.m.
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FRANCIS PITTIS AND SON will sell by Auction on the premises the
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PATENTS

PATENTS ACT, 1949

NOTICE is hereby given that Dowty Equipment, Ltd., seek leave to amend the Complete Specification of the Application for Letters Patent No. 649,970 for an invention entitled "Improvements in liquid-fuel burners."

Particulars of the proposed amendments were set forth in the Official Journal (Patents), No. 5280, dated March 5th, 1952.

Any person may give Notice of Opposition to the amendment by leaving Patents Form No. 39 at the Patent Office, 25, Southampton Buildings, London, W.C.2, on or before April 5th, 1952.

J. L. BLAKE,
Comptroller-General.
[7827

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More and more Owners of GOOD aircraft are finding it most advantageous to place the disposal of their aircraft in the hands of Aerocontacts Limited.

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EX-EMPLOYEES B.E.A.C. Northolt Airport who lived in Hostel between 1946-1951 are invited to contact Aeronautical Engineers Association, 108 Church Street, Croydon. [7662

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TIME recorders service rental. Tel.: Hop. 2256.—Time Recorder Supply and Maintenance Co., Ltd., 187-189, Borough High St., S.E.1. [7366

STAFF (tem checking and job-costing time recorders (all makes) for quick cash sale; exceptional conditions.—Box 7761. [7840

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LEARN to fly for £34: instructors' licences and instrument flying for £3 an hour; night flying £3/10/- an hour, residence 4½ gns. weekly. Approved M.C.A. private pilot's licence course.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome, Andover, Hants. [0250

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

ROYAL NAVY

SHORT SERVICE COMMISSIONS IN THE INSTRUCTOR BRANCH

APPLICATIONS are invited from university graduates and qualified teachers under 26 years of age for short service commissions of 3, 4 or 5 years in the Instructor Branch, Royal Navy. Requirements are mainly for officers with qualifications in mathematics, science (physics, chemistry, metallurgy) or engineering, but a few vacancies exist for officers with degrees in English, history or geography, with a sound mathematics or science background. Opportunities will be afforded for officers, after two years' service, to be selected for permanent commissions. A short service commission in the Instructor Branch will discharge any candidate's obligation under the National Service Acts.

2. Entry will be in two grades. Selected candidates with first or second-class honours degrees receive approximately £410 in their first year's service, £420 in the second year, £540 in third and fourth years, £594 in fifth year. Other candidates receive £319 in first year, £362 in second and third years, £429 in fourth and fifth years. Previous officer service in the recent war will be recognised for adjustment of seniority and rate of pay on entry. Accommodation and rations are provided, or allowances in lieu. Married officers, if aged 25 or over, receive marriage allowance of £230 per annum if not accommodated in official married quarters, £283 per annum if they are so accommodated and £195 per annum in either case if under 25. An initial outfit allowance of £141 is paid, together with a free issue of certain articles of clothing. A reduced allowance is payable to candidates with previous Naval service as officers. Tax-free gratuities of £300, £450 or £600 are payable at the end of 3, 4 or 5 years respectively.

3. Instructor officers serve both ashore and afloat, and their duties include both technical instruction and general education. Officers with suitable qualifications may also be trained and appointed for full- or part-time meteorological and weather forecasting duties.

4. Service in the Instructor Branch will, if desired, be treated as contributory service under the Teachers' (Superannuation) Acts, superannuation contributions being deducted from the annual gratuities.

5. Apply to Director (P), Naval Education Service, Admiralty, London, S.W.1, for fuller details and application forms. [7839

CITY OF COVENTRY EDUCATION COMMITTEE

COVENTRY TECHNICAL COLLEGE

Principal: F. V. Field, B.Sc., M.I.E.E.

APPLICATIONS are invited for appointment of senior lecturer in the Mechanical Engineering Department, to commence duties as soon as possible.

CANDIDATES should be honours graduates or hold equivalent qualifications and have had appropriate industrial or service experience, and preferably some teaching experience.

THE post will be allocated to aeronautical engineering, and for this post candidates must have specialist knowledge of aerodynamics and either aircraft structures or engines.

SALARY in accordance with the 1951 Burnham Scales for senior lecturers (£1,000 by £25 to £1,150).

APPLICATION forms and further information obtainable from the undersigned, to whom the completed forms should be returned within 14 days of the appearance of this advertisement.

W. L. CHINN,
Director of Education.

Council House,
Coventry.
February, 1952. [7802

SITUATIONS VACANT

NEW ZEALAND

APPLICATIONS are invited from suitably qualified persons for appointment as flight testing officer, Civil Aviation Branch, Wellington, Air Department, New Zealand.

COMMENCING salary will be £900 N.Z. per annum, rising to £980 N.Z. per annum, plus £80 a year flying allowance.

APPLICANTS must have had an extensive experience in all-in flying training, preferably experience as an instructor at a flying instructor school, and administrative experience in flying training. They must also either hold or qualify for at least a commercial pilot licence, an "A" category instructor rating and an instrument rating.

FURTHER details, together with the necessary application forms, can be obtained from

THE HIGH COMMISSIONER FOR NEW ZEALAND, 415, STRAND, LONDON, W.C.2,

mentioning this paper and quoting reference No. 247/30. Completed applications should be lodged not later than April 30th, 1952. [7822

THE DE HAVILLAND AIRCRAFT CO., LTD., HAVE VACANCIES FOR SENIOR DESIGN AND INTERMEDIATE DRAUGHTSMEN

PREFERABLY WITH AIRCRAFT EXPERIENCE IN THEIR HATFIELD AND LONDON (REGENT STREET) OFFICES.

Applications, stating age, experience and salary required, to

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HATFIELD, HERTS [6901

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APPLICATIONS are invited from suitably qualified persons for the posts (2) of airport foremen, Ringway Airport, at a salary in accordance with Miscellaneous Grade IV (£400-£470) of the National Scheme of Service Conditions. Duties will include supervision of portering, aircraft marshalling, freight loading, etc.—Further details, together with application form, are obtainable from the Acting Airports Manager, Ringway Airport, Manchester, on receipt of a stamped addressed envelope. The form should be returned to the same address by March 26th, 1952. Canvassing is prohibited.

PHILIP B. DINGLE,
Town Clerk.

Town Hall,
Manchester, 2.
March 6th, 1952. [7808

NAVAL AVIATION

YOUNG men between 17 years and 24 years are required for short service commissions in the ROYAL NAVY for eight years' flying duty as pilots or observers. It is intended that up to 20 per cent. of those completing the engagement shall, if suitable, be given permanent commissions. The remainder will pass to the Reserve for seven years and be paid a tax-free gratuity of £1,500. Applicants must have School Certificate with a pass in mathematics or a General Certificate of Education with passes at ordinary level in English language, mathematics and one other subject, all taken at the one sitting, or equivalent educational qualifications, and be physically fit.

Write to Secretary of the Admiralty (C.W.A(O.F.)), Queen Anne's Mansions, London, S.W.1. [7805

BLACKBURN AND GENERAL AIRCRAFT, LTD.* have vacancies for the following personnel on an expanding programme of work of national importance:—

STRESSMEN, senior and intermediate, with sound qualifications and aircraft experience.

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Applications, giving particulars of age, training, experience, etc., to:—

The Personnel Superintendent,
BROUGH, YORKS. [7713

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APPLICANTS should have honours degree or certificate in mechanical engineering, workshop practical experience, and be capable draughtsmen. Experience should cover organisation and administration of drawing office engaged on aircraft parts and associated equipment.—Box 7652. [7810

VICKERS-ARMSTRONGS, Ltd. (Aircraft Section), have vacancies at Hurn Depot for the following staff:—

AIRCRAFT STRESSMEN,
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(aircraft experience preferable, but not essential),
JIG AND TOOL DRAUGHTSMEN
(aircraft experience preferable, but not essential).

APPLY, in writing, to the Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. Applications are subject to the approval of the Ministry of Labour and National Service. [7783

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JAMES YOUNG, Ltd., Bromley, Kent, urgently require bench fitters for aircraft metal components.—Apply to your local Ministry of Labour and National Service. [7788

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SENIOR design and intermediate draughtsmen, preferably with aircraft experience, for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light structural or mechanical engineering. Possession of O.N.C. or H.N.C. (Mech. or Elect.) an advantage.

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SENIOR and intermediate draughtsmen.

STRESSMEN.

EXPERIENCED spares compilers.

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ELECTRICIAN for aircraft and Link trainer maintenance. Knowledge of radio an advantage.

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SENIOR planning engineers, for machine shop, press and fitting shops.

APPLY to nearest Ministry of Labour for Submission Card. [7818

STRESSMEN required for aircraft structural work.—Tiltman Langley Laboratories, Ltd., Redhill Aerodrome, Surrey. [7793

AIRFRAME and Engine Fitters required immediately.—Apply Starways Limited, Liverpool Airport, Liverpool. [7824

AIRCRAFT or mechanical draughtsmen required, all grades, for appointment at Langley Offices.—Apply, in first instance, stating age, experience and salary required, to:—

THE Chief Draughtsman, Alan Muntz and Co., Ltd., (Aircraft Section), Heston Airport, Hounslow, Middlesex. [7830

DESIGNER draughtsman with experience in light engineering, electrical knowledge an advantage. Salary according to qualifications.—Bryans Aeroquipment Ltd., Willow Lane, Mitcham Junction. [7742

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LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply by letter or telephone, to the Senior Radio Engineer, Aviation Traders, Ltd., Southend Airport, Essex. Tel.: Rochford 56491. [7690

REQUIRED immediately, Dakota captains. Salary in accordance with B.A.L.P.A. rates.—Apply, Chief Pilot, Air Transport (Charter) (C.I.) Ltd., Blackbushe Airport. [7781

H. M. HOBSON, Ltd., Fordhouses, Wolverhampton, require draughtsmen for design of test rigs and test equipment in connection with aircraft fuel systems and hydraulic accessories.—Apply through local Employment Exchange. [7829

LANCASHIRE AIRCRAFT CORPORATION, Ltd., invite applications for rate-fixers at Bovingdon and Squire's Gate in their engine electrical, airframe, instrument and radio sections.—Apply to the Personnel Manager, Bovingdon Airport, Herts. [7825

SENIOR designer draughtsman required, S.E. London area, with experience of design and development of aircraft instrument mechanism.—Applicants should write, stating age and salary expected, with details of experience, to Box F.926, at 191, Gresham House, E.C.2. [7803

JUNIOR draughtsmen required, S.E. London area, with experience of design and development of aircraft instrument mechanism.—Applicants should write, stating age and salary expected, with details of experience, to Box F.927, at 191, Gresham House, E.C.2. [7804

LANCASHIRE AIRCRAFT CORPORATION, Ltd., require qualified pilots, navigators and radio officers for their York Division.—Please forward full details to the Personnel Manager, Lancashire Aircraft Corporation, Ltd., Bovingdon Airport, Hertfordshire. [7805

AT Carlisle. Commercial pilot, I/R, not required. A Salary according to experience, plus 10/- per hour expenses plus commission. Also "D" licensed engineer; £500 p.a. plus bonus. Bungalow available.—Reply: Air Navigation, Ltd., Blackpool. [7806

WEIGHT estimator required by Percival Aircraft, Ltd., Luton Airport, Beds, for work on fixed wing and helicopter aircraft.—Apply, giving details of age, qualifications, experience and salary required to: Manager, Ministry of Labour and National Service, Luton, Beds. [7692

GLOSTER AIRCRAFT Co., Ltd., have vacancies for fully experienced aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, must be made through an Employment Exchange or Scheduled Agency. [7810

ARMSTRONG SIDDELEY MOTORS have a few vacancies for senior and junior stressmen to do work on strength investigations and calculations on gas turbine aero engines. Degree, Higher National Certificate or equivalent essential. This is work of prime national importance. There are also a few vacancies for senior and junior stressmen for work on the installation of gas turbines in aircraft.—Apply in some detail to Reference S.J.S.1. [7840

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Engagements will be arranged through the Ministry of Labour where necessary.

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HANDLEY PAGE (READING), Ltd., The Aerodrome, Woodley, Reading, have vacancies in their design office for senior and intermediate draughtsmen with aircraft experience. The positions are progressive and offer excellent opportunities for the right men. Please send full particulars to the Personnel Officer. [0874]

GLOSTER AIRCRAFT Co., Ltd., require senior and junior weight engineers. Interesting work on new projects. Permanent positions offered to suitable applicants. —Applications in writing, stating age, experience, qualifications and salary required, must be made through an Employment Exchange or Scheduled Agency. [0812]

EXPERIENCED drawing office checker required to check detail drawings and general arrangement drawings of aircraft hydraulic components and undercarriages, etc.—Write, stating age, experience and salary required, to Mr. R. J. Brown, Chief Draughtsman, British Messier Ltd., Cheltenham Road East, Gloucester. [7766]

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [7842]

TECHNICAL assistants required for development of small mechanical/electrical aircraft components. Degree, Higher National Certificate or equivalent essential.—Apply, in writing, to Chief Development Engineer, Wilkinson Sword Co., Ltd., Poyle Mill Works, Colnbrook, Bucks. [7778]

DRAUGHTSMEN, Design, detail and checker required for work on gas turbine fuel systems. Experience in light hydraulics an advantage, but not essential. Good salary, pension scheme.—Apply: Personnel Dept., Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7776]

AIR FORCE, naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd., Luton Airport, Beds. Applications are invited from senior and junior draughtsmen, and stressmen for work on this interesting programme.—Write, giving details of experience and salary required, to Manager, Ministry of Labour and National Service, Luton, Beds. [0866]

JIG and tool draughtsman (age 25-35) required by manufacturers of automobile and aircraft accessories in South Midlands. Practical experience in toolroom and production shops and good technical qualifications essential. Salary according to ability. Single accommodation available. State salary, age and full particulars. Box 7841. [7838]

THE GLOSTER AIRCRAFT CO. requires senior and intermediate stressmen to work on designs of future projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Applications in writing, giving full particulars of technical qualifications, age, experience and salary required, must be made through an Employment Exchange or Scheduled Agency. [0911]

LICENSED aircraft engineer holding A.C. for Dakota required immediately for six months' detachment, Rangoon. Excellent pay and allowances. Employment in U.K. on return. Single man preferred, but not essential, although family may not accompany to Rangoon.—Write, giving full details experience, to Silver City Airways, Ltd., 1, Great Cumberland Place, W.1. [7809]

DESIGN draughtsman required by Lockheed Hydraulic Brake Co., Ltd., Leamington Spa. Should be fully experienced in light mechanical engineering. Knowledge of hydraulics an advantage. Opportunity for early promotion to section leader grade on proof of ability. Single hostel accommodation available.—Apply Employment Exchange. [7930]

RESEARCH engineer required for turbine laboratory, experienced in precise measurement of gas flow and familiar with scientific experimental techniques. Successful candidate will operate plant and be responsible for care and accuracy of instrumentation.—Apply: Personnel Officer, Sir George Godfrey and Partners, Ltd., Hampton Rd., Hanworth, Middlesex. [7749]

APPLICATIONS are invited from senior and intermediate design draughtsmen. Experience of aero-engine design desirable, but not essential. Also checkers. —Please write, state age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. Apply Employment Exchange. [0930]

ROLLS-ROYCE, Ltd. (Barnoldswick Division), have immediate vacancies for jig and tool draughtsmen for work on aero-engine components. Salary according to ability and experience. Applicants having a good practical and technical background should state age, experience and full particulars to Labour Manager, Rolls-Royce, Ltd., Barnoldswick, Via Colne, Lancs. [7812]

ROLLS-ROYCE, Ltd. (Barnoldswick Division), have immediate vacancies for mechanical designers for work on the development of special machine tools, for use in the manufacture of aero-engine components. Applicants should have a good practical background and technical education.—State age, experience, qualifications and salary required to Labour Manager, Rolls-Royce, Ltd., Barnoldswick, Via Colne, Lancs. [7810]

EXPERIENCED stressmen required by Percival Aircraft, Ltd., Luton Airport, Beds, for responsible position in stress office. Minimum requirements H.Sc. (or equivalent), several years' experience, ability to take charge of stressing of complete aircraft.—Applications, in writing, to Manager, Ministry of Labour and National Service, Luton, Beds, giving details of training, experience, age and salary required. [0868]

HANTLEY PAGE, Ltd., have a vacancy for a technical assistant with a good mechanical engineering background, who will be required to carry out work in connection with thermo-dynamic problems for aircraft air conditioning and thermal de-icing systems.—Write, stating age and giving particulars of qualifications and experience, to: Staff Officer, Handley Page, Ltd., Clarement Rd., London, N.W.2. [7788]

TECHNICAL assistants, both junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections dealing with rig tests of engine components, vibration, static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [0869]

MECHANICAL engineering draughtsman required, preferably with experience of test rigs, for hydraulic equipment. Good opportunity for man with previous experience of the mechanical design for test rigs for aero-engine hydraulic accessories. First-class working conditions and good salary.—Apply: Personnel Dept., Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7796]

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.—Applications should state full particulars of experience and qualifications and should be addressed to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. Apply Employment Exchange. [0852]

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SITUATIONS VACANT

TECHNICAL authors and illustrators required by Percival Aircraft, Ltd., Luton Airport, Beds. Knowledge of M.o.S. procedure desirable.—Applications, in writing, stating age, experience and salary required to Manager, Ministry of Labour and National Service, Luton, Beds. [7804]

DRAUGHTSMAN, Blackburn (Dumbarton), Ltd., Castle Rd., Dumbarton, require immediately a fully qualified draughtsman for their aircraft drawing office. Experience in the design and modification of aircraft is essential and considerable liaison duties are involved. Excellent working conditions, canteen facilities and a staff pension scheme is in operation. Applications, stating full details of qualifications, experience and age, to be addressed to labour manager. [7788]

BRITISH OVERSEAS AIRWAYS CORPORATION invite applications for the position of engineering instructor (electrical and instruments), to be stationed at Filton, Bristol. The duties include instruction on electrics, instruments and auto-pilots to pilots, flight engineers and engineering personnel. Applicants must have technical knowledge to "E" licence standard, ability for clear self-expression and for writing training manuals, lecture notes, etc. At least 5 years' practical aircraft maintenance and overhaul experience is necessary. Salary, £565-£700 per annum, according to qualifications and experience.—Applicants in writing to Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middx. [7811]

SITUATIONS VACANT

THE GLOSTER AIRCRAFT Co. requires the services of a number of aerodynamicists (a) for design and project work, and (b) for flight test reduction. Opportunity exists for individuals to vary their experience within the Aerodynamics Department. Candidates with some years' experience preferred, but applications from juniors with sound mathematical ability will receive full consideration. —Applications in writing, giving full particulars of age, experience and salary required, must be made through an Employment Exchange or Scheduled Agency. [7813]

TECHNICAL Illustrators required for expanding publications department to prepare exploded and cut-away sectional views of fuel-system components for gas turbine aero engines. Applicants must have sound art school and technical experience, and possess ability to grasp and illustrate clearly the construction and operation of components from blueprints.—Write, stating age, experience and salary required, to Personnel Dept., Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7797]

TECHNICAL authors required for expanding publications department to prepare descriptive, overhaul and servicing manuals on fuel components for gas turbine aero engines. Applicants must be of Higher National Certificate standard, with sound practical engineering experience, and have the ability to write clearly in concise terms.—Write, stating age, experience and salary required, to Personnel Dept., Joseph Lucas (Gas Turbines Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7798]

BRITISH EUROPEAN AIRWAYS have vacancies at Renfrew for planner/ratefixers. Applicants, preferably having served a 5 years' apprenticeship in engineering, should have planning or ratefixing experience in manufacture or repair of aircraft, engines, components or accessories. After qualifying periods, pension and sick pay schemes, holidays with pay and air travel concessions operate. Salary scale, £10 by 5/- to £11 per week.—Applications in writing to Base Personnel Officer, British European Airways, Airport for Glasgow, Renfrew. [7821]

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SITUATIONS VACANT

CHIEF flying instructor required by Derby Aero Club to commence duties end of March. Qualifications necessary: good instructional background, full G.A.P.A.N. endorsement; preference given to commercial licence holder. Good salary for suitable applicant, together with possibility of unfurnished accommodation.—Apply in writing in first instance, giving full details of experience and career, to Derby Aero Club, Ltd., Municipal Airport, Burnaston, near Derby. [7792]

THE College of Aeronautics. English Electric Research Fellowship in Aeronautics. Applications are invited for a Research Fellowship which has recently been established at the College by the English Electric Co., Ltd. The Fellowship is intended to provide opportunity for post-graduate research into problems of vibration stability and control of aircraft, and is tenable for one year beginning on or about October 1st, 1952. The value of the Fellowship is £900. Applications, giving full particulars of education and experience and quoting the names of three referees, are required by May 1st, 1952 and should be addressed to: The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks. [7830]

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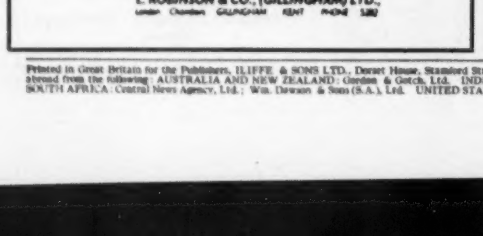

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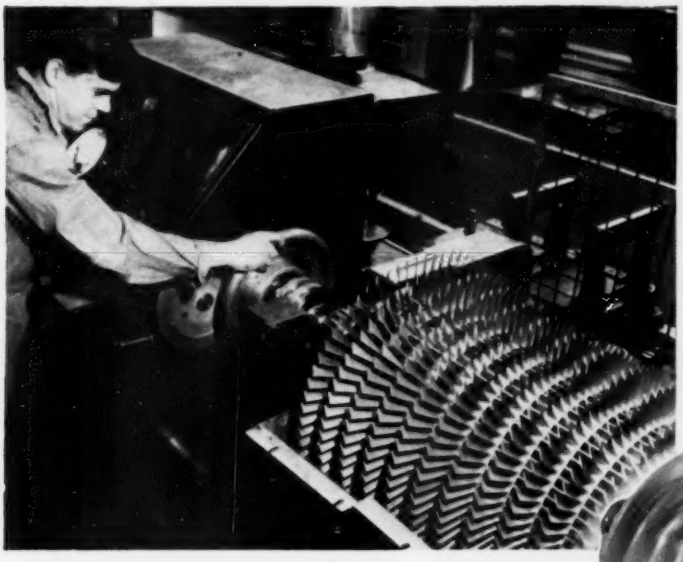
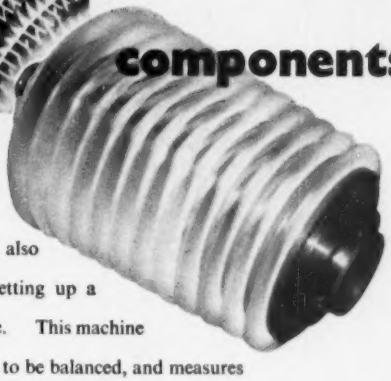
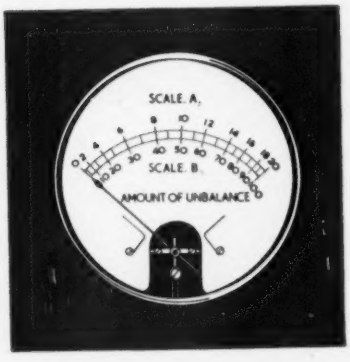


Dynamic balancing of rotating components



To minimise vibration and reduce bearing loads at the high speeds employed in turbine engines, it is not sufficient for rotating components to be simply in static balance, they must also be dynamically balanced. The operator in the illustration is setting up a Proteus compressor rotor on a "Gisholt" dynamic balancing machine. This machine rotates the component to be balanced, and measures the bearing reactions at each end of the rotor. Electronic equipment determines the magnitude and location of any out-of-balance forces, so that they may be eliminated, either by adding or removing metal at the appropriate positions. All the major rotating components of "Bristol" turbine engines are dynamically balanced before assembly into the engine. The machine illustrated is one of many similar balancing machines used in the "Bristol" workshops.



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